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VOL. CXXXIV.—No. 3495] LONDON: FRIDAY EVENING, DECEMBER 22, 1922 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

India Office, Whitehall, S.W. 1.

By Order of the Secretary of State for India in Council.

REQUIRED for service in the Superior Revenue Establishment of Indian State Railways (North-Western Railway),

ONE ASSISTANT BRIDGE ENGINEER.

Candidates must have had a good general and technical education and must possess the Associate Membership of the Institution of Civil Engineers or hold an exempting degree. They must have had practical experience in structural engineering and be able to design large girders in all details.

Age not less than 28 nor more than 30 years. Bachelor preferred.

TERMS.—A 3 years' engagement in the first instance, first-class free passage to India and home again on satisfactory termination of service at the end of the first three years.

SALARY.—On appointment, age 28 and 29, Rs. 675; 30, Rs. 725; rising by annual increments according to scale in force for approved service.

The selected candidate will be required to pass the Medical Board, India Office, before appointment.

Application may be made by letter only, and candidates must give full particulars of their general and technical education and of their practical training. This information should be in chronological order, with dates. Age should be stated and details of war service (if any) given. Letters of application, with copies only of testimonials, should be sent to the undersigned not later than 31st December, 1922.

Messrs. RENDEL, PALMER and TRITTON.
12-14, Dartmouth-street,
Westminster, London, S.W. 1. 1037

The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of :—

1. PIPES, HOSE, CANVAS, BURNETTIZED, AND SCREWS, DELIVERY.
2. HAMMERS, PNEUMATIC, PILKINGTON SERIES O TYPE, or Similar.
3. SPRINGS, COIL, HELICAL AND VOLUTE.

Forms of Tender may be obtained from the Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than Two o'clock p.m. on Friday, the 12th January, 1923.

T. RYAN,
1026 Director-General.

Quantity Surveyor Re- QUIRED by the GOVERNMENT of the GOLD COAST for a tour of 8 to 12 months' service. Salary £480. Outfit allowance of £60 on first appointment. Free single quarters and passage. Liberal leave in England on full salary. Candidates, age 25 to 35, preferably unmarried, should be fully trained quantity surveyors with experience in ferro-concrete and other structures.

Apply at once, in writing, stating age and giving brief outline of qualifications and experience and stating whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/11,742. 1050

University of Cape Town.

CIVIL ENGINEERING DEPARTMENT.
ASSISTANT AND DEMONSTRATOR.

APPLICATIONS are INVITED for the POST of FIRST GRADE ASSISTANT AND DEMONSTRATOR in the Civil Engineering Department of the University of Cape Town. SALARY £350, rising by £25 per annum to a maximum of £450. An allowance of £40 will be made for passage money.

The duties of the post will include taking tutorial classes, assisting with the structural and design classes, preparing drawings, diagrams and cartoons, taking practical surveying, and generally carrying out the instructions of the head of the department. Applicants should have a good theoretical knowledge of engineering and be good draughtsmen and surveyors, and it is also desirable that they should have had some practical experience.

The successful applicant will be required to become a member of the University Teachers' Superannuation Fund and to take up his duties by 1st March, 1923.

Applications and copies of testimonials, all in duplicate, should reach the Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar-square, W.C., from whom forms of application may be obtained, not later than the 31st December, 1922. 961

Battersea Borough Council.

The Council invite TENDERS for the SUPPLY of :—

1. POWER-DRIVEN VERTICAL DRILLING MACHINE.
2. POWER-DRIVEN ENGINEERS' LATHE.

Particulars may be obtained on application to the Borough Engineer at the Town Hall, Lavender-hill, S.W. 11.

Persons tendering must pay the trade union rate of wages in all departments.

Tenders, endorsed "Tender for Drilling Machine and Lathe," addressed to the Town Clerk, must be delivered at the Town Hall, Lavender-hill, S.W. 11, not later than Twelve o'clock Noon on Monday, 1st January, 1923.

The Council do not bind themselves to accept the lowest or any Tender.

EDWIN AUSTIN,
Town Clerk.
December, 1922. 1040

Tyne Improvement Commission.

VERTICAL CROSS-TUBE BOILER FOR THE COMMISSIONERS' ALBERT EDWARD DOCK, NORTH SHIELDS.

The Tyne Improvement Commissioners are prepared to receive TENDERS for the CONSTRUCTION and DELIVERY of a VERTICAL CROSS-TUBE BOILER for their Cable Deals Yard, Albert Edward Dock, North Shields.

Copies of the form of Tender, conditions of contract, specification and drawing may be obtained on application to the undersigned on payment of a deposit of £1, which will be returned on receipt of a bona fide Tender.

Tenders, in sealed envelopes, endorsed on the cover "Tender for Boiler," must be addressed to the undersigned and delivered to him not later than Wednesday, the 3rd day of January, 1923.

The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order,
RICHARD AUGHTON,
General Manager.
Tyne Improvement Commission Offices,
Bewick-street, Newcastle-upon-Tyne,
16th December, 1922. 1031

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

A Study of Air-Steam Mixtures.

The Validity of Einstein's Doctrine.

British-built Sleeping Cars for France.

90 H.P. Petrol Engine for British Lifeboats (With a Two-Page Drawing).

A "Broadcasting" Station in Manchester.

Continuous Brakes for Goods Trains.

Principles of Boiler Design.

PUBLIC NOTICES

City of Oxford.

RECONSTRUCTION OF BULSTAKE BRIDGE.

Oxford Corporation invite TENDERS for the RECONSTRUCTION of BULSTAKE BRIDGE. The work consists of a Pile Foundation and Concrete Superstructure.

Plans may be seen at my office, and specification, quantities and form of Tender will be supplied to responsible contractors on receipt of a deposit of £5 5s. The deposit will be returnable on receipt of a bona fide Tender.

Sealed Tenders, addressed to me and marked "Bulstake Bridge," may be delivered by 10 a.m. on Monday, January 1st, 1923.

The lowest or any Tender will not necessarily be accepted.

J. E. WILKES,
City Engineer.
City Engineer's Office,
Town Hall, Oxford.
12th December, 1922. 995

State Electricity Commission OF VICTORIA.

TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form and specification may be obtained or inspected upon application to—

Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION No. 21/6.—ASH and DUST EXTRACTION PLANT.

CHARGE.—£2 2s. for the first two copies of Tender forms, conditions of contract and specification complete. This charge will be returned on receipt of a bona fide Tender. A third or any further copies will be supplied for the sum of £1 1s. each, not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £50 is required to be lodged with Tender.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m. on March 7th, 1923.

R. LIDDELOW,
Secretary,
983 State Electricity Commission of Victoria, Melbourne, Australia.

Urban District Council of WINDLESHAM (SURREY).

NEW SEWERAGE AND SEWAGE DISPOSAL SCHEME FOR BAGSHOT, LIGHTWATER, AND WINDLESHAM.

UNEMPLOYMENT RELIEF WORKS.

TO CAST IRON PIPE FOUNDERS.

The Urban District Council of Windlesham (Surrey) invite TENDERS for the SUPPLY and DELIVERY at Bagshot of about 350 TONS, more or less, of CAST IRON PIPES, varying in size from 2½in. to 15in. internal diameter; also a number of BENDS, TAPER JUNCTIONS, and other SPECIALS.

A copy of the specification and form of Tender may be obtained on application in writing to Major T. J. Moss-Flower, Civil Engineer, 28, Victoria-street, Westminster, S.W., and Carlton Chambers, Bristol, at his Bristol office, on and after 16th December, 1922, on payment of the sum of Three Guineas, which will be returned, provided a bona fide Tender be received and is not withdrawn before the acceptance by the Council of one of the Tenders.

Sealed Tenders, endorsed "Tender for Cast Iron Pipes," are to be delivered at my office at Bagshot by 4 p.m. on 29th December, 1922.

The lowest or any Tender will not necessarily be accepted.

Dated this 9th day of December, 1922.

By Order,
EDWYN T. CLOSE,
Solicitor and Clerk to the Council,
Council Offices,
Bagshot (Surrey). 1001

PUBLIC NOTICES

The Windlesham Urban District COUNCIL (SURREY).

BAGSHOT, LIGHTWATER AND WINDLESHAM SEWERAGE AND SEWAGE DISPOSAL WORKS.

CLERK OF WORKS

(To commence duties at an early date).

The Council invite APPLICATIONS for the above APPOINTMENT. Candidates must be thoroughly experienced in the Construction of Modern Sewage Disposal and Drainage Works, and be able to efficiently discharge the duties required of Clerk of Works on works of this kind, and must be competent with the use of the level and theodolite and be able to set out and measure up works and keep accounts, &c.

No others need apply.

Preference will be given to qualified ex-Service men.

The Clerk of Works will be required to act under the direction of Major T. J. Moss-Flower, the Council's Consulting Engineer, and to devote the whole of his time to the duties of his office.

Salary £8 per week.

Time about 15 months, subject to approved service, and the engagement to be terminable by a month's notice on either side.

Applications, marked "Clerk of Works," stating previous experience and enclosing copies of three recent testimonials, to be sent direct to the Engineer, at his Bristol Office, Carlton Chambers, Baldwin-street, Bristol, so as to reach him not later than NOON on Thursday, December 28th, 1922.

By Order,
EDWYN T. CLOSE,
Solicitor and Clerk to the Council.
Council Offices, Bagshot, Surrey.
9th December, 1922. 979

ENGINEERING ASSISTANT.

Required in the Water Engi- NEER'S OFFICE, TORQUAY, an ENGINEERING ASSISTANT. Salary £300 per annum.

Applicants to be good draughtsmen, experienced in the preparation of plans and estimates, and must have had experience in Waterworks Construction. Candidates must hold the certificate of Assoc. M. Inst. C.E. or qualifying university degree.

Applications must be made upon the form of application provided, which can be obtained from the Town Clerk, Town Hall, Torquay.

Canvassing, either directly or indirectly, will disqualify.

Applications, addressed to the Town Clerk, must be received on or before Thursday, January 11th, 1923.

SAMUEL C. CHAPMAN, M. Inst. C.E.,
Water Engineer.
Town Hall, Torquay. 1022

SITUATIONS OPEN

THE ADVERTISERS Have to INFORM APPLICANTS for POSITION as MACHINE SHOP FOREMAN, advertised in issue of December 8th, 1922, under Box No. 973, that the VACANCY is now FILLED. 1024 A

WANTED, a YOUNG ENGINEER, to Act as ASSISTANT WORKS MANAGER to a special foundry situated in Scotland. A young man trained in a well-organised shop, systematic, accurate, and energetic desired. Small commencing salary with good prospects. Please state details of previous employment, which will be treated confidentially.—Address, 1048, The Engineer Office. 1048 A

WANTED AT ONCE, TRAVELLER (Young), having thorough knowledge of Woodworking Machinery, to work South-Western District of England, working from Bristol. Bristol resident preferred.—Address, 1052, The Engineer Office. 1052 A

WANTED for a Large Engineering Works in Calcutta, MARINE ENGINEER as ASSISTANT in their Power-house and to look after Works Plant. At least two years' sea service in addition to full apprenticeship in marine engineering works essential. Age 24-26 years, 5 years' agreement.—Address, Z. E. 432, care Deacon's, Leadenhall-street, London. 1028 A

SITUATIONS OPEN (continued)

WANTED, Good Keen MEN with Shop Experience for Writing Out Material Specifications; good opportunities for right type of man; must be accurate and quick.—Address, stating age, experience and salary required, 991, The Engineer Office. 991 A

WATERWORKS COMPANY REQUIRES MECHANICAL ENGINEERING ASSISTANT with thorough knowledge Erection, Testing and Maintenance of Portable and Locomobile Steam Engines.—Address, stating experience and salary required, 1041, The Engineer Office. 1041 A

WANTED, WORKS MANAGER for Shale Works in England; one with knowledge of low-temperature retorting and oil fractionation preferred.—State full details of experience, age, testimonials, and salary required, to Box "K. N. W.," c/o Davies and Co., 95, Bishopsgate, E.C. 2. 1049 A

ENGINEER WANTED for London Office. Estimating and purchasing. Good technical and commercial knowledge. Salary commencing £550 per annum.—Address, 1030, The Engineer Office. 1030 A

INDIA.—STRUCTURAL STEEL WORK DRAUGHTSMAN REQUIRED by an English firm, able to work out stresses and prepare designs, estimates, and detail drawings for Roof, Bridge, and Girder Work, &c.; must be a bachelor, age 25-28.—Address, stating age and particulars of previous experience, 1045, The Engineer Office. 1045 A

ONE of the LEADING FIRMS in the COUNTRY, MANUFACTURING ELECTRICAL EQUIPMENTS for RAILWAYS, REQUIRES the SERVICES of an ENGINEER with CONNECTIONS in the RAILWAY WORLD and EXPERIENCE in RAILWAY ELECTRIFICATION.

Address, 1038, The Engineer Office. 1038 A

WANTED, an Experienced ESTIMATING DRAUGHTSMAN, used to Gas Plant and Structural Steel Work. Must be quick and accurate.—Address, stating age, experience, and salary required, P6610, The Engineer Office. P6610 A

WANTED, DRAUGHTSMAN for Oil Engine Designing, age about 27, with last three years on High Compression Heavy Oil Engines. State experience, age, salary, and when at liberty.—Address, 1034, The Engineer Office. 1034 A

WANTED by Leading Firm, SENIOR DRAUGHTSMEN, with first-class experience for Lay-out and Detail Work on Switchgear; none but first-class men need apply.—Address, stating age, experience and salary required, 999, The Engineer Office. 999 A

WANTED, Fully Qualified DRAUGHTSMAN for General Engineering Works. Must have good knowledge of Gas Plant and be used to taking out quantities.—Address, stating qualifications and salary required, P6608, The Engineer Office. P6608 A

WANTED, SEVERAL SENIOR SWITCHBOARD DRAUGHTSMEN.—Apply, stating age, experience and salary required, to BRITISH THOMSON-HOUSTON CO., Ltd., Drawing-office, Willesden N.W. 10. 1021 A

WANTED, TWO ENGINEERING DRAUGHTSMEN, accustomed to Aircraft Work.—Reply, Box 226, T. B. Browne's Advertising Offices, 163, Queen Victoria-street, E.C. 4. 1039 A

CHIEF DRAUGHTSMAN WANTED by Firm Manufacturing Hydraulic Pumps, Forging and Baling Presses, &c. Applicants must have sound theoretical training and wide experience in designing well-known firms. State age, training, full particulars of experience, and salary required.—Address, P6604, The Engineer Office. P6604 A

CONSTRUCTIONAL DRAUGHTSMAN. Must be experienced man with thorough knowledge of the Design and Construction of all types of Steel Structures. State age, experience, and salary required.—Address, 1033, The Engineer Office. 1033 A

DRAUGHTSMEN, Accustomed to Traction Control Gear, WANTED.—Address, stating age, experience, and salary required, 1035, The Engineer Office. 1035 A

SITUATIONS OPEN (continued Page 2.

SITUATIONS WANTED, Page 2.

PARTNERSHIPS, Page 2.

PATENTS, Page 2.

MACHINERY, &c., WANTED, Page 2.

FOR SALE, Pages 2 and 84.

AUCTIONS, Page 84.

PREMISES TO LET OR WANTED Page 2.

WORK WANTED, Page 2.

AGENCIES, Page 2.

MISCELLANEOUS, Page 2.

For Advertisement Rates See Page 667, Col. 1.

NUMERICAL INDEX TO ADVERTISEMENTS Page 83.

SITUATIONS OPEN (continued)

DRAUGHTSMAN REQUIRED IMMEDIATELY, with Switchgear and Overhead Transmission Line Experience.—Apply, stating age, experience, salary, to Box BB, c/o Industrial Publicity Service, Ltd., 4/7, Red Lion-court, Fleet-street, E.C. 4. 1025 A

GOOD DRAUGHTSMAN, Specialised in Switchboard Work, REQUIRED. Must have had good mechanical training. State age, experience, and salary.—Address, 900, The Engineer Office. 900 A

MACHINE TOOL DESIGNER WANTED for Special Tools. Applications are only invited from men of first-class ability. Reply, giving qualifications.—Address, "DESIGNER," Wm. Porteous and Co., Advertising Agents, Glasgow. P6575 A

MECHANICAL DRAUGHTSMEN REQUIRED for the Design of Mechanisms. Only good men with Shop Experience need apply. State age, salary and experience.—Address, 972, The Engineer Office. 972 A

FOREMAN WANTED in Old-established Railway Wagon Works in the Midlands, to Take Charge of Sawmill and Wood Wagon Building Shop. Must be conscientious, energetic, and used to the control of men. State age, experience, and salary required. Applications will be treated in strictest confidence.—Address, 1044, The Engineer Office. 1044 A

SITUATIONS WANTED

BUYER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, Z. M. 613, c/o Deacon's, Leadenhall-street, E.C. 1000 B

DIESEL ENGINE DESIGNER, with Charge of Oil engine department abroad, WISHES SIMILAR POSITION in this country.—Address, P6609, The Engineer Office. P6609 B

ENGINEER (48), M.I. Mech. E., 1st Class B. of T. Cert., OPEN ACCEPT suitable POSITION home or abroad, from 1st Feb.
Abroad since 1901, eleven years supt. eng. S.S. Coy., with repair shops; ten years mangr. shipyard and floating dock Coy.
N.E. ship and eng. surveyor. Lloyd's, acting surveyor, Bureau Veritas and British Corporation.
Address, P6567, The Engineer Office. P6567 B

SALES ENGINEER SHORTLY DISENGAGED. Practical, theoretical and commercial experience in marine, mining, electrical and mechanical engineering; age 26 years.—Address, P6527, The Engineer Office P6527 B

WANTED, SITUATION as FOREMAN SMITH; used to ship repairing and public works. Excellent references; would not object to going abroad.—Address, P6607, The Engineer Office. P6607 B

PARTNERSHIPS

ENGINEERING PARTNERSHIPS AND BUSINESSES.

Wheatley Kirk, Price & Co.,
46, Watling Street, London, E.C. 4.

Established seventy years.

AGENCIES

AGENT WANTED by the ANDERSON-GRICE CO., Ltd., to cover Lancashire and Cheshire for Cranes and Stone-working Machinery. Applicants must be experienced engineers, preferably with practical knowledge of building and monumental trades, possess good office facilities and able to work the ground thoroughly and systematically.—Apply, MANAGING DIRECTOR, Tarmouth Engineering Works, Carnoustie. 1027 D

EXPERIENCED ENGINEER, A.M.I.C.E., M.I.M.E., DESIRES to ACT as REPRESENTATIVE ENGINEER in London for good provincial, continental or other firm.—Address, P6512, The Engineer Office. P6512 D

SOLE DISTRIBUTORS WANTED for Successful Patent Engineers' Tool. Increasing sales, large turnover. State territory and what other lines handled.—THE D.C.M. TAP CO., Ltd., 177, West Regent-street, Glasgow. 1053 D

EDUCATIONAL

A BROCHURE on "ENGINEERING SALESMANSHIP and SALES MANAGEMENT," with particulars of a SPECIAL COURSE of TRAINING, will be sent post free on application to SECRETARY, THE INSTITUTE OF ENGINEERING SALESMANSHIP, 333, Oxford-road, Manchester. P6195

CORRESPONDENCE COURSES for Inst. C.E., Inst. Mech. E., London Univ. (Matric., Inter., and B.Sc.) personally conducted by Mr. TREVOR W. PHILLIPS, B.Sc. (Honours), Assoc. M. Inst. C.E., M.R.S.I., F.R.S.A. &c. Also Day Tuition in Office. Excellent results at all Exams. Courses may commence at any time.—8/11, Trafford Chambers, 58 South John-street, LIVERPOOL. Ex. S

INST. C.E., Inst. Mech. E., B.Sc., and all ENGINEERING EXAMINATIONS.—Mr. G. F. KNOWLES, M.B.E., B.Sc., A.M. Inst. C.E., &c., personally PREPARES CANDIDATES, either orally or by correspondence. Thousands of successes during the past sixteen years. Course can be commenced at any time.—39, Victoria-street, Westminster S.W. Telephone No., Victoria 4780. Ex. S

LARN SURVEYING AND LEVELLING.—Thorough practical instruction given by an expert.—Address, E. MOUL (late L.S.W. and S.P.D. Rlys.) Hollybeak, Woking. P6221 S

TUITION BY POST.—Inst. C.E. and I. Mech. E. Enrol now for next Exams.; 100 per cent. passes last examination. Reinforced Concrete, new comprehensive course under expert engineer, £3 3s. Write for particulars.—PENNINGTONS, University Tutors, 254 Oxford-road, Manchester. Estab. 1876. Ex.

FOR HIRE

FOR HIRE, PUMPS and WELL-BORING TOOLS for Contractors' Deep Wells, &c., 2in. to 24in. dia.—R. RICHARDS and CO., Upper Ground-street, London, S.E. Telephone No. 978 Hop. S22 K

FOR SALE or HIRE, ELECTRIC MOTORS, from 60 to 300 H.P.; PORTABLE STEAM ENGINES, from 8 to 40 N.H.P.; STEAM BOILERS, CRANES, PUMPS, MACHINE TOOLS of every description; reasonable terms, immediate delivery.—J. T. WILLIAMS and SONS, 37, Queen Victoria-street, London, E.C. Tel., City 4936. Ex. K

MISCELLANEOUS

MACHINE TOOL MAKERS, with Well-introduced Specialities in Horizontal, Radial and Vertical Drilling and Boring Machines, are OPEN to DISPOSE of DRAWINGS, JIGS, DESIGNS, and MANUFACTURING RIGHTS. Great development possible to enterprising practical men.—Address, 1023, The Engineer Office. 1023 A

IF YOU REQUIRE
DIVIDING HEADS for MILLING.
ROTARY TABLES for
SLOTTING and MILLING.
Write to
THE WHEELER MNFG. CO. Ltd.,
65F, Trench Crossing, Wellington, Salop.

PATENTS

INVENTIONS DEVELOPED, PATENTED, and SOLD for Clients by Engineers (late of Vickers Ltd., B.Sc., M.R. Ae. S., A.M.I. Ae. E.). Strictest confidence, most moderate terms.—FORTIS and PARTNERS, 60, Queen Victoria-street, E.C. 4. Tel., Cent. 3864. 512 H

TO SHIPBUILDERS, SHIPOWNERS, MARINE ENGINEERS, PUMP MFS., AND OTHERS.
THE ELEY SYSTEM
FOR KEEPING DAMAGED SHIPS AFLOAT.
OFFERS are INVITED for the PURCHASE of the following valuable BRITISH PATENTS:—

2321/1915.—Combined System of Indication Pumping, Pump Starting and Water Levelling.

2580/1915.—Bulkheads Form One Side of Pumps to Reduce Weight.

3735/1915.—Cofferdam Bulkhead for Containing Pumps and Pipes.

118,790.—One Salvage Pump to Operate Automatically on Two or More Compartments.

120,617.—Sectional Collision Mats.

124,270.—Salvage Pumps Operated by Main or Propeller Shafts.

Further particulars may be obtained from CHARLES V. A. ELEY, 10, Cambridge-crescent, Edgbaston, Birmingham, to whom offers should be sent before January 31st, 1923, for all or any of the Patents. P6611 H

PATENTS, "IMPROVEMENTS IN BALING PRESSES."—The PROPRIETORS of WELGER BROS. TWO BRITISH PATENTS Nos. 145,542 and 145,543 are DESIROUS of LICENSING them to British Manufacturers on reasonable terms to ensure their MANUFACTURE and DEVELOPMENT in Great Britain, or of SELLING the PATENTS outright.—For full information address inquiries to W. P. THOMPSON and CO., Chartered Patent Agents, 12, Church-street, Liverpool. P6606 H

THE PROPRIETOR of BRITISH PATENT No. 148,867, dated January 5th, 1916, relating to "Improvements in LUBRICATORS for SPRINGS," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of exploiting the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 974 H

THE PROPRIETORS of PATENT No. 160,686, "DIMINISHING RECOIL of GUNS," are DESIROUS of ENTERING into ARRANGEMENTS by way of LICENSE and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country.
All communications should be addressed in the first instance to J. E. EVANS-JACKSON and CO., Patent Agents, 57/60, Holborn-viaduct, London, E.C. 1. P6576 H

THE PROPRIETORS of LETTERS PATENT No. 114,183, relating to "Combined Stone Breaker and Road Roller," DESIRE to DISPOSE of the PATENT or to GRANT LICENCES to interested parties at reasonable terms with a view to the adequate working of the patent in Great Britain.
Inquiries to be addressed to the PATENTEE, Konsortiet, Via Mariestad, Sweden. P6602 H

THE PROPRIETORS of BRITISH PATENT No. 121,374, relating to "Machines for Cutting Natural or Artificial Stone," are DESIROUS of ENTERING into NEGOTIATIONS with one or more firms in this country, either by way of a LICENCE or LICENCES or by the SALE of the PATENT RIGHTS for the purpose of EXPLOITING the invention and ensuring its full development and practical working in this country.
Inquiries should be addressed to WM. BROOKES and SON, 55-56, Chancery-lane, London, W.C. 2. P6505 H

THE PROPRIETORS of the PATENT No. 156,583, for "An Improved Apparatus for Filtering," are DESIROUS of ENTERING into ARRANGEMENTS by way of LICENCE and otherwise on reasonable terms for the purpose of EXPLOITING the same and ensuring its full development and practical working in this country.
All communications should be addressed in the first instance to HASELTINE, LAKE and CO., Chartered Patent Agents, 28, Southampton-buildings, Chancery-lane, London, W.C. 2. 1047 H

MACHINERY, &c., WANTED

WANTED, a 3-THROW VERTICAL HYDRAULIC PUMP, 21in. ram, 6in. stroke, working pressure 1200 lb. per square inch.—Address, 1036, The Engineer Office. 1036 F

WANTED, HORIZONTAL TANDEM COMPOUND CONDENSING ENGINE, 300 B.H.P. for 150 lb. boiler pressure, with rope fly-wheel.
Also TWO BOILERS, 30 by 8ft. 6in., to reinsure 150 lb. pressure. Must be good condition.
Major CLIFFE, Ltd., Milnsbridge. 1017 F

WANTED IMMEDIATELY, STANDARD GAUGE STEAM LOCOMOTIVES: Two 14in. Four wheelers and Two 12in. Six-wheelers; must be in perfect condition, and modern locos. by first-class makers. Preferably situated in South of England. Low price essential. Must insure at 160 lb. w.p.—Address, 985, The Engineer Office. 985 F

WANTED, 200-TON SCREW PRESS with Automatic Ejector, suitable for briquetting. Best price for re-sale.—Write, "P. I." c/o Charles Barker and Sons, Ltd., 31, Budge-row, E.C. 4. 1029 F

FOR SALE
Continued from page 84.

PORTABLE RAILWAY MATERIAL, WAGONS, TRACK, CROSSINGS, TURNTABLES, &c.—PLEASE NOTE.—We are now in a position to SUPPLY NEW MATERIAL of superior make from stock at lowest prices.—JOSEPH PUGSLEY and SONS, Ltd., Cattybrook Ironworks, Lawrence-hill, Bristol. Telegrams, "Piston, Bristol." Telephone No. 126. 338 G

PRESS, ONE NEW HYDRAULIC BALING, Capacity 300 tons; cost about £4500; offers invited.—The LIQUIDATOR, Scottish Mesopotamia Corporation, Ltd., 31, George-street, Edinburgh. 809 G

RAILWAY MATERIAL.—NEW and SECOND-HAND CREOSOTED SLEEPERS and CROSSING TIMBERS from large stocks. All sections of NEW and SECOND-HAND STEEL RAILS with accessories.
H. H. NEAL and CO., Contractors' Engineers, 53 The Broadway, Ealing, London, W. 5. 396 G

SALE, Cochran VERTICAL TUBULAR BOILER, 16ft. by 7ft. 6in., 720 square feet heating surface, 100 lb. pressure, equal new, with fittings.—Apply, P. BAKER and CO., Ltd., Albion Works, Cardiff. 766 G

FOR SALE.
THREE LANCASHIRE BOILERS, 30ft. by 8ft., now in 1917, re-insure 100 lb. working pressure.
THREE LANCASHIRE BOILERS, 30ft. by 7ft. 6in., now insured at 150 lb. pressure.
ONE LANCASHIRE BOILER, 17ft. by 5ft. 6in. diameter, re-insure 80 lb. pressure.
ONE LANCASHIRE BOILER, 30ft. by 8ft. 6in., suitable for 160 lb. pressure.
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Continuous Brakes for Goods Trains.

ALTHOUGH the paper on "The Braking of Goods Trains," written jointly by Sir Henry Fowler and Mr. H. N. Gresley, was read before the Institution of Civil Engineers as long ago as January 10th last, it was not until recently that the discussion thereon was published. We welcome its appearance, as the equipment of continuous brakes to goods trains is one of the means that make for the more economical and efficient working of railways. When such trains are fully braked they can be run at a higher average speed, as they can then pull up, when approaching a station or a signal at "danger," in a shorter distance and thus steam need not be shut off until later than is now the case. A higher average speed provides a quicker clearance of the line, and more trains can, therefore, be run and, furthermore, passenger trains are not delayed by goods trains nor fast goods by slow goods. Signalmen, too, need not shunt goods trains so early for other trains to pass, and when more important trains are behind them, drivers can, without risk, accelerate their own movements so as not to delay the following trains. A greater density of traffic is, therefore, possible, and there is less necessity for the provision of independent lines for freight traffic. Quicker transit means more "output" per day for each driver, fireman and guard, and more earning power for every locomotive and wagon. It also implies quicker delivery of consignments, and their shorter occupancy of the track.

The provision of continuous brakes to goods trains leads to the diminution of accidents. Goods trains pull up more quickly should a collision be imminent; the occasional cases of trains getting out of control descending severe gradients are less likely to happen, and when such trains became divided, owing to a coupling failing, both portions are automatically stopped, and in consequence there is no fear of the second portion overtaking the first, nor of a signalman, when the first portion passed, "clearing" the line and accepting a second train which would collide with the first. The dangers of this sort that are removed by the equipment of continuous brakes to freight trains may be judged by the fact that about 12,000 couplings fail every year. Occasionally serious results arise from these failures. One such was on the East London in August, 1921, when two servants were killed. This accident led Colonel Pringle to observe in his annual report, that it indicated the necessity for the use of a continuous brake with goods trains.

The present restricted loading for trains that have to descend steep gradients could be modified were greater brake power available. Then there remains the fact that automatic train control cannot be made as efficient on goods trains as on passenger trains unless the former have continuous brakes and, therefore, control will be more costly to instal, and it will be less effective, until the brake power of all trains is of the same proportion. This, we know, means the equipment of privately-owned wagons. Therein lies a serious difficulty as, although the Ministry of Transport has power under the Act of 1919 to prescribe the type and capacity of such wagons, this power applies only to future wagons and not to any that were in use, under repair, or in course of construction when the Act was passed. But since these wagons are almost solely employed in carrying coal, coke, lime and such slow-moving traffic, they might be placed in trains to themselves. Whilst that course would prevent the wholesale quickening up of trains and would not wholly remove the coupling danger nor the automatic train control difficulty, it would allow railway-owned wagons, when braked, to be more effectively employed.

But as soon as—possibly before—it were agreed to equip goods trains with continuous brakes, it would have to be decided which of the two systems, Westinghouse or vacuum, should be adopted. Some may suggest that this question has already been answered by the fact that the vacuum brake is the only one fitted to those wagons which already have continuous brakes. But the matter is not so readily settled. The tests that Sir Henry Fowler and Mr. Gresley made provide a proof of this, whilst their results show that much more remains to be done before the vacuum can be offered for acceptance as the only brake. In the discussion that followed the reading of the paper in question, no one suggested that the vacuum was superior to the Westinghouse brake, but there were assertions that the case was the other way round—that the Westinghouse was the better. In this connection let us emphasise that the authors made it clear that they had no idea of comparing one brake with another; their sole purpose was "to ascertain the suitability of the vacuum brake for long freight trains." Judged by its ability to stop a train in the shortest possible distance, the Westinghouse may be, we think, the better brake. It is more quickly applied and sooner released; has other merits of which a prominent one is less dead weight. On the other hand, the vacuum has a distinct advantage in its greater simplicity. It scores, too, by the fact that, as regards the goods stock already equipped, it is in full possession of the field, whilst, in respect of passenger stock, it is in the majority. In passing, it may be of interest to note that whilst, under grouping, the Caledonian and Brighton companies may join their respective allies and abandon the Westinghouse, the London and North-Western Company will have more passenger vehicles fitted with the Westinghouse brake than with the vacuum.

The trials of June and July, 1919, were the first of their kind, as till then the question had not been tackled by any company, and was, it would seem, inspired by the brake question on the Continent, of which we will speak in a moment. They were, to quote Mr. Gresley, "not made with the idea of getting ideal stops—such as had been got on the Continent with both vacuum and Westinghouse brakes—but rather to experiment with the existing equipment of the English railways." The result showed that "it is practicable, with the vacuum brake, to work long trains of up to 100 wagons, provided that suitable accelerators and reducing nipples (valves) are used." Emergency stops can be made without shock with such trains, but when service stops and speed reductions are required the brake, if the speed be less than 30 miles per hour, must be applied slowly. That means a greater braking distance but allows the brakes to be partly released so that the train can get under way again almost immediately. Mr. Gresley would appear to have no doubt as to the successful use of the vacuum brake, and it must be remembered that the Great Northern runs daily vacuum-fitted trains of sixty wagons. Mr. Collett, too, mentioned that since 1905 the Great Western had been running a large number of vacuum-fitted fast goods trains. But that company allows only thirty-five wagons to have their brakes coupled up. No reason for this course was given, but it may be assumed that the object is to secure uniformity of application and of release. It is therein, we should say, that improvements are required, and why tests should be made with trains of both loaded and empty wagons; with wagons having screw couplings of varying tightness, and with those equipped with three-link couplings and with variations in the piston movements. The importance of the retention of the three-link coupling was pointed out by Mr. R. W. Reid, of the Midland Railway, who said that of the 1,500,000 wagons in the country only 20,000 has screw couplings. It is, let us add, the three-link coupling that furnishes the greatest problem in continuous brake equipment for goods trains. The brake application being made by the engine, the wagons in front are first affected, and thus those in the rear bunch up and they and their contents are severely shaken. Were screw couplings used, and they were tight, there would be only a compression of the buffers. The engine would, however, have greater difficulty in starting the train.

FRENCH PLANS.

In France, whilst there are comparatively few goods vehicles equipped with continuous brakes, events have moved much faster than in this country, as the French Government has been taking action independently of *L'Unité Technique des Chemins de Fer*. This international body, which was founded in May, 1886, to deal with technical questions that affect all the continental railways, meets in Berne—it is often referred to as the Berne Convention—and its work was described in THE ENGINEER of December 18th, 1914. It has been dealing with, among other matters, the question of continuous brakes for goods trains. The subject was first considered at a meeting in May, 1907. In May, 1909, specifications were drawn up. Tests were made in Austria in September, 1911, with the Clayton-Hardy vacuum brake, and in Hungary in October, 1913, with the Westinghouse. In September, 1914, trials were to have been made, on the invitation of the German delegates, with what is now known as the Kunze-Knorr air brake. Despite the fact that, owing to the war, these tests could not be made and, therefore, *L'Unité Technique* had not approved, it was adopted by the parties to the German Railway Union, and all its wagons were to be equipped by 1927. The Peace Treaty, therefore, contained a clause—article 370—whereby Germany undertook to fit its wagons with such a brake that would not impair the making of any continuous brake which might be adopted by the Berne Convention within ten years of the signing of the Peace Treaty. Prior to the war, the Paris, Lyons and Mediterranean Company was making tests with the Westinghouse brake for goods trains, and *L'Unité Technique* was waiting for an opportunity to see the results when war broke out. The action of the German railways, together with such serious accidents as that at Houilles on October 9th, 1920, impelled the French Government to hasten a decision as to the most suitable brake for freight trains, and the Minister of Public Works had a Commission appointed which made tests with the Westinghouse, Clayton-Hardy, and Lipkowski—the last an air brake used on the Paris Metropolitan. The results, which were related on page 336 of our issue of September 26th last, were such that the Commission recommended to the newly-appointed *Conseil Supérieure des Chemins de Fer* that the Westinghouse be adopted. The report said that the Clayton-Hardy gave the best results on long gradients, and that it had a slight advantage in stopping distance, but the Westinghouse gave smoother braking effects and was already in use on passenger trains and on the *petite ritesse* vans. We remarked, in giving this information, that the *Conseil Supérieure* would have to consider the report and, were it approved, the French Government would be invited to take steps for *L'Unité Technique* to bring the matter before the other Governments party to the Convention. Now, concurrently with the appearance of the discussion on the paper by Sir Henry Fowler and Mr. Gresley, comes the news from our Paris correspondent, published on page 621 of our issue of December 8th, that the conclusions of the Commission that made the trials in France have been objected to, and that it is considered that the only practical way to decide the respective merits is to fit a number of goods trains in actual service and run them as long as possible. We do not quite know what is here proposed, but it is clear that the French battle of the brakes is not yet concluded.

Coal Wharf and Machinery of the North-Western Fuel Company of America.

No. III.*

HAVING described the coal wharf, its construction and its machinery equipment for unloading coal from steamers, we come now to the methods and mechanical appliances used in handling, screening, sorting and shipping the coal. With two distinct kinds of coal—anthracite and bituminous—handled at this wharf, two separate and complete plants are required for preparing the various commercial grades or sizes of each kind of coal.

BITUMINOUS COAL PLANT.

All coal is unloaded and placed in storage by the 570ft. gantry or coal-handling bridge which travels along the entire length of the wharf. But in addition to this, the bituminous coal is sorted and prepared for shipment by machinery mounted in a house attached to the rear tower or leg of the bridge, being delivered to it by the 10-ton grab bucket operated by this bridge. This machinery house is shown in Figs. 11 and 12, page 666. A flow diagram showing the several stages or processes of preparing and handling the coal is given in Fig. 6.

Coal from the ship or the stock pile is discharged from the bucket into a 50-ton bin in the screening house, and is either shipped as "run-of-pile" coal or passed through the screens to be graded as "stove," "nut," and "screenings." For each of these sizes there is a 50-ton bin, from which shipment is made. All these sizes can be loaded into open railway wagons by means of the long jibs carrying conveyor belts, as shown in Fig. 12, page 666. They can be loaded also into two box cars or covered wagons simultaneously by means of two loading jibs and two box car loading machines. These loaders have conveyors in hinged troughs, which can be entered into the side door of the wagon and adjusted to deliver the coal into either end of the wagon, which is usually 30ft. to 35ft. long. One of these loading machines is shown in Fig. 13, page 666, folded back against the tower of the bridge and out of service. The smaller sizes and the finer waste due to screening can be deposited in separate stock piles or in six bins placed along the driveway of the wharf for loading into carts or motor trucks for local distribution. A portable loading machine can be used also to load coal from these special stock piles into carts and trucks.

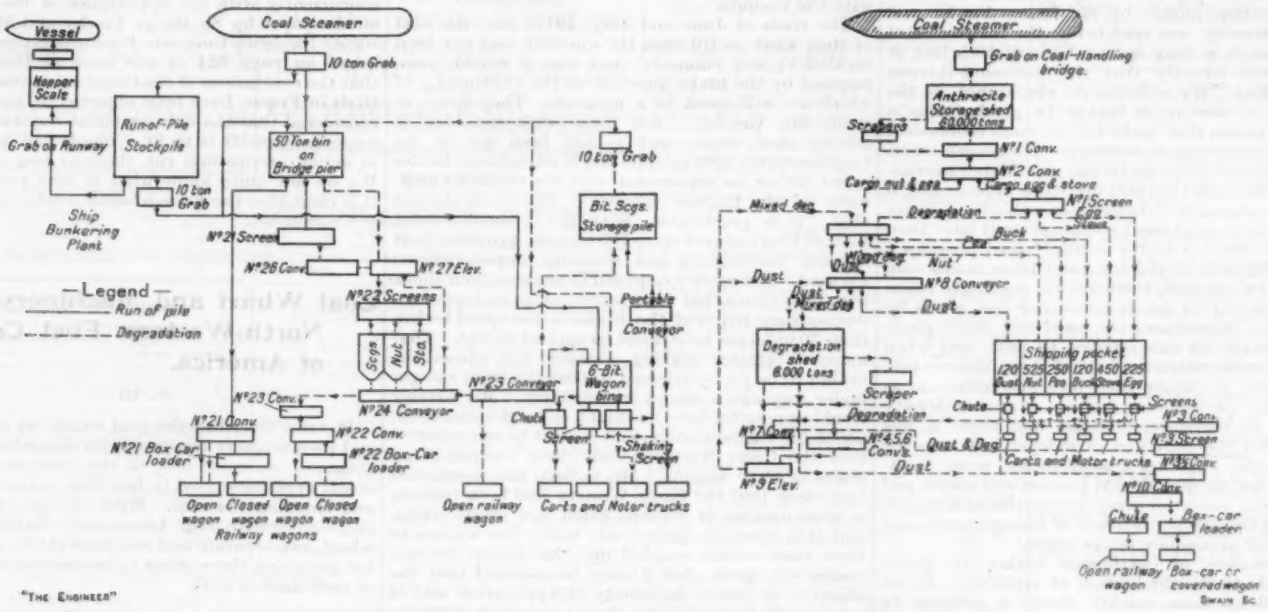
Each of the six bins for local service—shown in Figs. 1 and 4 *ante*—is of timber construction, 30ft. by 36ft. and 36ft. high, with separate compartments for "run-of-pile," "lump," "stove," "nut," and "screenings." One compartment is equipped with a shaking screen and undercut gates for preparing lump coal. The other compartments have two stationary gravity screens and one blind chute for "stove," "nut," and "screenings" respectively. All the compartments have hatch covers to protect the coal from the weather. These bins are loaded by the grab bucket of the coal-handling bridge or by belt conveyor No. 23—see Fig. 6—on a 100ft. swinging jib mounted on the bridge tower. From these bins coal can be loaded into carts or motor trucks at the rate of 1000 tons in ten hours.

The loading or shipping capacity of this bituminous plant varies from 2000 to 6000 tons in ten hours. This capacity depends upon whether run-of-pile or screened coal is being loaded, whether it is loaded into open or closed wagons, and whether the loading is done at one or two points. The front or water side tower of the bridge is designed to permit of installing upon it an equipment for loading bituminous run-of-pile coal into railway wagons, in order to supplement the loading facilities on the rear tower. The installation of a second coal-handling bridge, with a duplicate of the present equipment for the preparation of bituminous coal, is also contemplated.

For supplying bituminous coal to tugs and small steamers there is a bunkering plant at the head of the wharf. This is shown in the plan, Fig. 4 *ante*, and the stages of operation are shown at the left of the flow diagram, Fig. 6. The equipment consists of a timber runway carrying a cable haulage system, which

* No. II. appeared December 5th.

operates a grab bucket for taking coal from the stock pile, and a scraper bucket, operated by an electric reversible winding engine. The coal is delivered to a weighing hopper mounted on a 50-ton hopper scale, from which it flows down a chute to a 24in. belt conveyor carried on a jib or boom, which can be tilted and swung laterally to deliver coal to vessels of different heights.



FIGS. 6 AND 7—FLOW DIAGRAMS FOR BITUMINOUS AND ANTHRACITE COAL HANDLING

10-ton grab of the coal-handling bridge to be lowered into the shed and thus deposit the coal directly and quietly on the stock pile. This avoids breakage due to dropping the coal from a height. Heavy plank stiffened by knee braces. Across the beams are laid the joists for the plank roofing. In each bay or panel of the roof is a hatch or opening 8ft. square, fitted with a removable cover. These openings enable the bulkheads retain the coal within the shed. These are held by inclined timbers, which become anchors when embedded in the coal pile. The construction of this shed and its accessories is shown in Fig. 8.

drawings, is a 36in. belt, 517ft. long, and having a carrying capacity of 300 tons per hour at a belt speed of 250ft. per minute. It is placed in a tunnel of reinforced concrete extending under the centre of the shed and supported on pile foundations, as shown in Fig. 9. In inside dimensions it is 9ft. 6in. wide and 9ft. 2in. high, with a semi-circular roof arch rising above the floor of the wharf. Along each side of the exposed arch are openings spaced 8ft. apart, the openings on opposite sides being staggered in relation to one another.

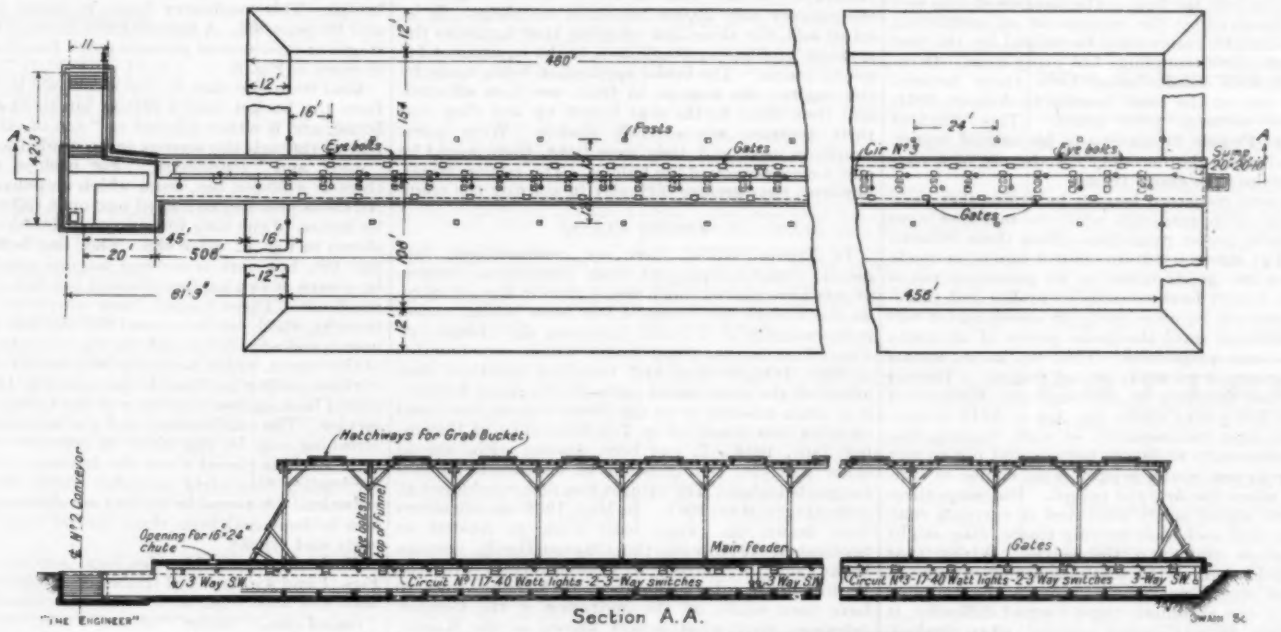


FIG. 8—SHED FOR STORING 100,000 TONS OF ANTHRACITE COAL

ANTHRACITE STORAGE AND SCREENING.

On this coal wharf anthracite coal is stored under cover, not because it deteriorates by exposure to the weather, but because it loses its bright sheen when exposed, and there is a popular opinion that the "dull" coal has lost some of its heating property. For this reason a shed 480ft. long and 286ft. wide is provided. The shed is of timber construction, with posts spaced 24ft. on centres in both directions and supporting lines of roof beams, the framing being

The coal is reclaimed or removed from storage by a belt conveyor in a tunnel beneath the shed. In order to trim the coal to the tunnel openings when it does not flow to them by gravity, the shed is fitted with "flying scrapers." These are blades operated in pairs, with a single endless cable to each pair, so

The tunnel openings, which admit the coal from the stock pile in the shed, are fitted with chutes and undercut gates, the gates being operated from the inside of

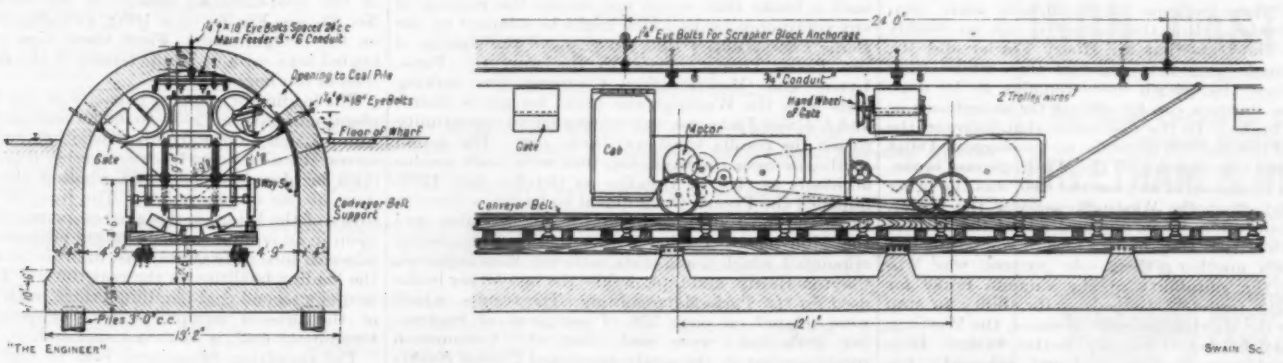


FIG. 9—CONVEYOR TUNNEL AND FEEDER FOR REMOVING ANTHRACITE FROM STORAGE SHED

the tunnel. An electrically propelled feeder travels over the conveyor and is placed under the gate which is to be opened. Thus the coal does not fall from a height on to the conveyor belt, but falls only a few inches into a hopper, from which it flows smoothly on to the belt. This tunnel, with its gates, conveyor and travelling feeder, is shown in Fig. 9.

The main conveyor, No. 1, delivers the coal to a similar conveyor, No. 2, which is at right angles to the former and rises on an incline so as to discharge into the top of the 1600-ton shipping pocket. This second conveyor is 284ft. long and has the same speed zontal shaking type, 6ft. wide, with a length of 33ft. for No. 1 and 43ft. for No. 2. Each screen consists of an upper deck provided with perforated screen plates designed to convey the coal forward, and a lower deck with blank plates only, this latter being designed to convey the coal in the reverse direction. The two screen decks travel at the same speed, but in opposite directions. They are also made of the same weight, so that their action is counterbalanced, thus reducing vibration to a minimum.

The driving heads of these screens consist of a continuous shaft, on which are mounted two pairs of of 110 revolutions per minute and is provided with a 12ft. perforated section for removal of the "nut" and smaller sizes. The coal thus passed through the screen is conveyed on the lower deck and delivered to No. 2 screen to be re-sized into "nut," "pea," "buckwheat," and "dust" sizes.

Furthermore, screen No. 1 is provided also with a 10ft. perforated section for separating the "stove" from the "egg" coal. The "egg" passes over the screen to a 225-ton pocket, while the "stove" size is conveyed to a 450-ton pocket by means of the lower horizontal deck of the screen.

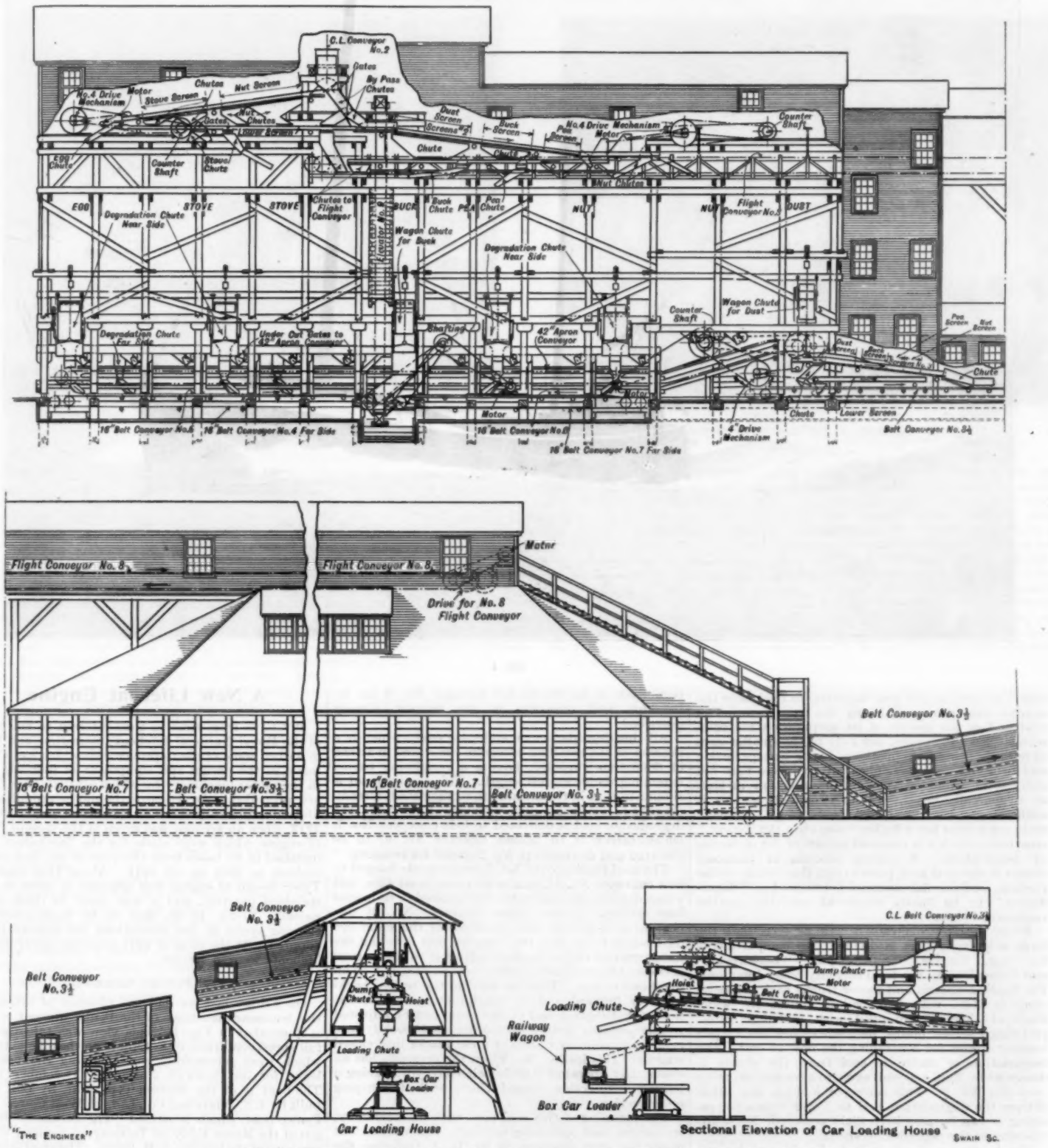


FIG. 10—ARRANGEMENT OF MACHINERY FOR SCREENING AND SORTING ANTHRACITE

and carrying capacity as the other. Each one is driven by an electric motor of 40 horse-power.

From this point begins the preparation of the anthracite and its separation or grading into several commercial sizes. The routes of the coal through the several stages or processes is shown by the diagram Fig. 7, while the arrangement of the machinery is shown in Fig. 10. At the head of the inclined conveyor No. 2 is a bifurcated chute or inclined trough, which, by means of a flap gate, either passes the "stove" and "egg" sized coal to cargo screen No. 1, or the "nut" coal to cargo screen No. 2, depending upon the cargo size which is being handled.

These screens are of the Jacobsen balanced horiball-faced excentrics, each pair operating one deck of the screen. A fly-wheel pulley imparts to the shaft a speed which at first is slow, but which is accelerated toward the end of the forward stroke and is then reversed at high speed for the return stroke. This arrangement ensures a continuous and uniform travel of the coal at a speed suitable for effective screening. Each screen deck is mounted on four sets of floating rollers, which are equipped with spring equalisers to keep them in alignment and to ensure smooth operation. The screening section of each upper deck has a pitch or inclination of about 6 deg.

When cargo "egg" or "stove" coal is screened it is delivered to screen No. 1, which is run at a speed

Screen No. 2 has perforations in the upper deck for the passage and removal of "pea," "buckwheat" and "dust" sizes, which are conveyed to their respective storage bins or pockets by the lower deck. The distribution is controlled by means of gates and chutes. The "dust" is deflected sideways by a diagonal baffle across the lower deck of the screen near the discharge end. In this way it is delivered to a flight conveyor 225ft. long, which carries it either to the "dust" pocket or to the degradation shed, as shown by the flow diagram Fig. 7. This conveyor may be used also for stocking mixed degradatiou from the No. 2 screen in the degradation building.

It may be explained here that the term "degrada-

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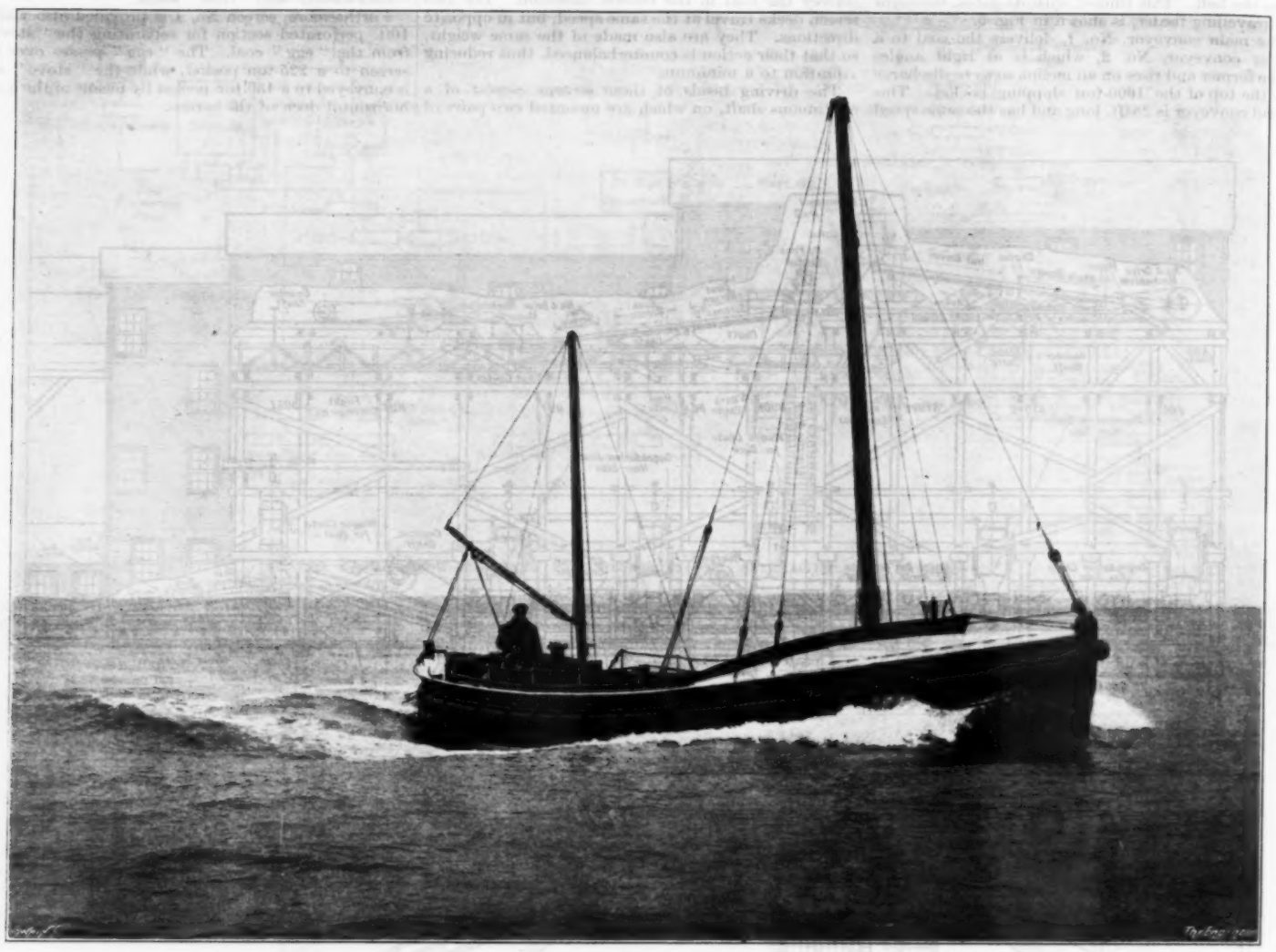


FIG. 1

tion" is used in the coal industry to designate the smaller sizes produced during the transportation of coal and in the course of its preparation for commercial use. It applies, not only to the smaller sizes or fines resulting from breakage during transportation and handling, but particularly where these fines are reduced in value on account of reduction in size, as is generally the case. An exception to this is anthracite "nut" screened from cargo "stove," since the former has a higher value than the "stove" sizes from which it is removed as part of the undersize or degradation. A certain amount of breakage occurs in the coal as it passes from the screens to the pockets, and this fine material is removed as "degradation" to be finally separated into the smaller commercial sizes.

From the flow diagram it will be seen that the large shipping pocket is divided into compartments for "egg," "stove," "nut," "pea," "buckwheat," and "dust" sizes, the total capacity being 1600 tons. For loading wagons and motor trucks each compartment is fitted with two loading chutes 4ft. wide. Each of these is equipped with undercut gates, perforated screen plates, de-grade chutes and hinged loading aprons for controlling the flow of coal. The degradation or undersize coal from the chutes is delivered by 16in. belt conveyors to a bucket elevating conveyor No. 9. This conveyor in turn can either deliver the degradation coal to No. 2 screen for re-sizing or can by-pass it to flight conveyor No. 8 for stocking in the degradation shed.

For loading coal which is to be shipped by rail there are in the bottom of the shipping pocket thirteen undercut gates to deliver the coal to No. 3 conveyor. This is of the steel apron type, 42in. wide and 120ft. long, running at a speed of 80ft. per minute. The conveyor discharges on to No. 3 screen, the upper deck of which has "dust," "buckwheat," "pea," and "nut" perforations for taking out any degradation or undersize coal which may have collected in the pockets. The screen is operated by the Jacobsen driving mechanism already described. Its upper deck is fitted with hinged folding veil plates for quickly adapting the screen to the removal of such fines or undersize material as will occur with the size of coal being handled. The degradation or undersize coal which passes through the upper deck of the screen is delivered by side discharge from the lower deck to degradation belt conveyor No. 7, which in turn feeds it to the bucket elevator No. 9 for re-handling and screening in the manner already described.

All this degradation or undersize coal—which is a product of the handling processes—is stored in a shed of 6000 tons capacity, having a reclaiming tunnel extending under its full length. This arrangement is similar to that in the anthracite storage shed, already described. Through gate openings 10ft. apart the degradation coal is delivered to belt conveyor No. 7, which carries it to bucket elevator No. 9, to be elevated and delivered to No. 2 screen for re-sizing.

The coal passing over No. 3 screen is discharged to belt conveyor No. 3½, this being an inclined 42in. belt which delivers the coal to the loaded shed to be loaded into railway wagons. Here conveyor No. 3½ discharges to a shuttle belt conveyor of the same size on loading boom No. 10. Raising and lowering the discharge end of this boom to adjust it to the wagons is effected by means of an electric hoist or winch on an overhead trolley. Thus by moving the trolley backward or forward and by manipulating the electric hoist the discharge end of the boom can be adjusted to any position desired for loading coal directly into open wagons or by means of a car loader into closed wagons. This loader, No. 20 on the diagram, has an electrically operated shuttle belt conveyor, having a jointed two-section hinged chute with telescoping lower section.

The planning of this coal pier, with its machinery, equipment and operating methods, was worked out under the joint direction of Mr. B. A. Galleher, the general superintendent, and Mr. G. H. Hutchinson, the chief engineer, these gentlemen representing the commercial and technical sides of the company's business. Mr. E. N. Saunders, jun., is president of the North-Western Fuel Company, Mr. Benjamin Gorham is vice-president and general sales agent, and Mr. J. H. Macoubrey is secretary. The coal-handling machinery includes the specialities of a number of large manufacturing concerns.

THE Rand Water Board has decided to proceed with the second unit of the Vaal River scheme, at an estimated cost of £501,190, to provide an additional 5,000,000 gallons of water a day.

A New Lifeboat Engine.

WE have from time to time referred to the work of the Royal National Lifeboat Institution, and have described some of the improvements which have been made in the design and equipment of lifeboats and in the motor machinery by which all the newer boats are propelled. An article on the motor propulsion of lifeboats will be found in THE ENGINEER for March 1st, 1912, when an account was given of the various types of engine which were made for the Institution, and installed in its boats from the year of the first motor lifeboat in 1904 up till 1911. About that time the Tylor design of engine was adopted as more or less standard practice, and it was made in three sizes, namely, 30–35, 40–50, and 55–60 horse-power, a running speed of 700 revolutions per minute being adopted. At the close of 1911 nineteen motor-driven lifeboats were in service.

THE PENLEE LIFEBOAT.

On Friday last we had the pleasure of attending the demonstration trials of the Penlee lifeboat, which is illustrated in Fig. 1. This view was taken under full-speed conditions of 8.4 knots on the official trials, which were successfully run, enabling the boat to leave for its Cornwall station on December 16th. The boat is of the Watson type, 45ft. by 12ft. 6in., built by J. S. White and Co., Ltd., at West Cowes. The Penlee boat, which is named "The Brothers," is the gift of the Misses Eddy, of Torquay, in memory of the two sons of the late Mr. J. R. Eddy. The chief interest of the boat is that it is the most powerful on our coasts, and the first to be fitted with the new 90 horse-power engine designed by the Lifeboat Institution. With this latest addition to the motor fleet there are now thirty-eight motor lifeboats out of a total of 238 lifeboats in service.

Before proceeding to describe the new engine, a few words may be devoted to the equipment and the engine arrangement in the boat. The machinery is placed amidships, and is accommodated in a completely enclosed water-tight casing having six 21in. by 15in. hatches which allow of access to the engine. All controls are brought out to the instrument board at the aft end of the engine casing, where the driving platform is arranged, and the instruments and control connections are in water-tight casings, the following measurements being recorded: Oil

temperature at exit and entry, circulating water temperature at outlet, speed of engine, voltage, and current, and air pressure in the petrol tanks, while a tell-tale is provided on the cooling water circuit. The main controls are the driving wheel operating the reversing gear and a maximum and minimum throttle indicator lever, which predetermines the throttle position, and is combined with the driving wheel in such a way that only one movement of the wheel is necessary to control and manœuvre the boat. The mechanism consists essentially of a heart-shaped plate cam fixed to the control shaft which operates a plunger connected through heavy clock-type coil springs to the throttles. The action of moving the wheel to either the ahead or astern position opens the throttles the pre-arranged amount, and in coming into neutral closes them to the predetermined minimum. This arrangement, which we noted worked satisfactorily throughout the trials, has been designed to prevent any possibility of stopping the engine even under the most adverse conditions, and at the same time it reduces the human element of control to one movement only. At the instrument board are starting devices for the main and starting engines, petrol supply tank controls, and a sea water valve. Normally the fresh water cooling circuit is a closed one, but arrangements are made for auxiliary cooling by opening the pump suction to the sea. Filters accessible from the deck are placed on the suction side of the pump. Beneath the driving platform is a well through which the propeller shaft passes, while between the engine shaft and the propeller shaft itself—which is sealed with a gun-metal gland—a breaking piece of hollow cast iron is provided. This part, which would collapse should the propeller strike a foreign object, is renewable and can be quickly replaced. The main exhausts are water-cooled, and pass by means of a tee piece beneath the driver's seat to either side of the boat, a non-return valve being fitted between the tee piece and the sea outlet on each side.

The instrument board and the engine-room casing are illuminated by lamps on the main dynamo circuit, which also includes the navigation lights and a telescopic disappearing headlight, which is housed on the towing bollard aft. Forward of the engine casing is a mechanically operated winch driven by means of a simple clutch gear from the main engine. This winch is controlled from deck by a screw-down valve which regulates the clutch position.

DESIGNING THE NEW ENGINE.

The period when the Committee of Management of the Institution decided that the time had come for it to design a special marine petrol engine to meet the arduous conditions of lifeboat service happened to coincide with a revival of trade throughout the country. It therefore came about that J. Tylor and Sons were not able to complete their offer to build the first engine, owing to other pressing business commitments, and in the early stages of the design the whole of the work was taken over by the Institution itself. The drawings and patterns already made were acquired, and the work proceeded in the drawing-office of the Institution, Mr. A. C. Butcher, the technical engineer in charge of the work at Tylor's, being transferred and working along with the Institution's surveyor of machinery, Mr. Arthur F. Evans, on the design and development of the engine. Valuable expert advice was received from two members of the Committee, Engineer-Vice-Admiral Sir George G. Goodwin and Engineer-Rear-Admiral Charles Rudd, whose opinions were of considerable service in assisting the technical staff to decide on the method of building the engine, and selecting a firm for the assembly and testing. Various component parts were taken as separate items, and the firms most suited to supply those parts were asked to tender. Thus, for example, Willans and Robinson were chosen to supply and machine the main body casings, and the examples we saw in course of erection were certainly fine specimens of light and sound iron castings. The Weyburn Engineering Company, Ltd., of Elstead, Surrey, was entrusted with the work of building the engine, and after examining the component parts and noting the standard of workmanship on engines in course of assembly, we can only say that the Committee's choice has been justified. The keen interest of the proprietor of these works, Mr. Hamilton Gordon, has been an important factor in the success of the engine. Unfortunately, just after the engine was finished and tested and ready for dispatch, a disastrous fire took place at the works of the Weyburn Engineering Company, Limited, and a part of the engine was completely destroyed. The rebuilding of the engine had one happy feature, namely, that minor troubles which presented themselves in the first test were completely avoided. Indeed, the engine ran its official tests, and throughout the 1200 miles run, which has been made since the engine was placed in the boat, no trouble of any kind has been experienced, although the boat has been run in all possible weather conditions. Having briefly outlined the genesis of the new engine, we are now in a position to consider some of the constructional details.

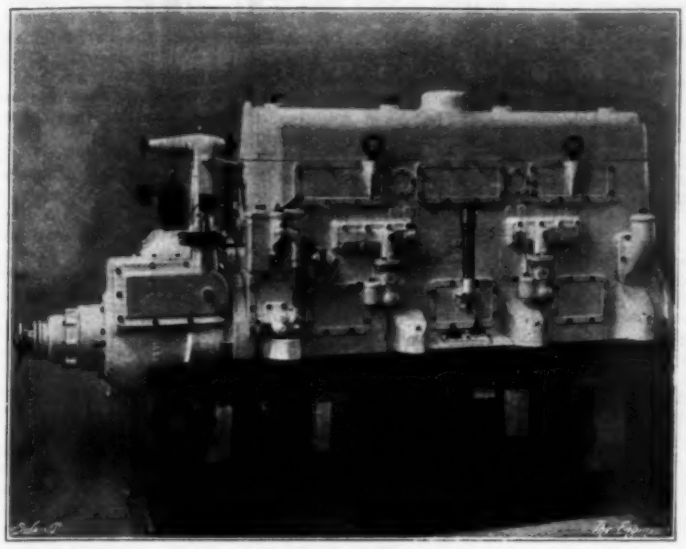


FIG. 2—LIFEBOAT ENGINE—STARBOARD SIDE

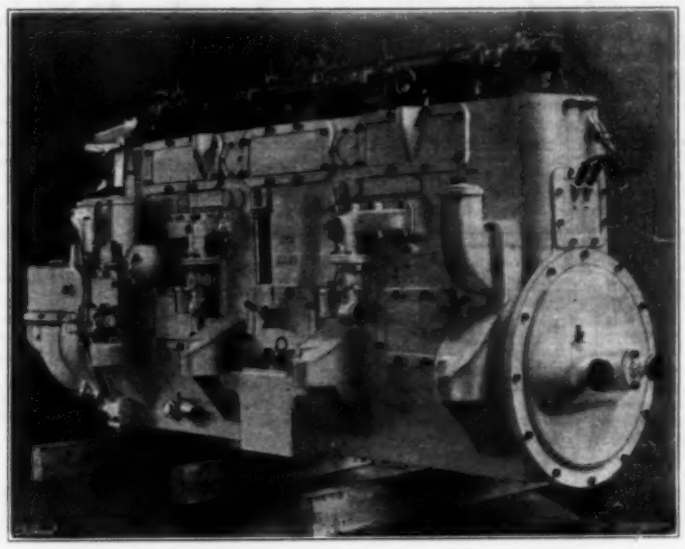


FIG. 3—ENGINE WITH TOP COVER REMOVED

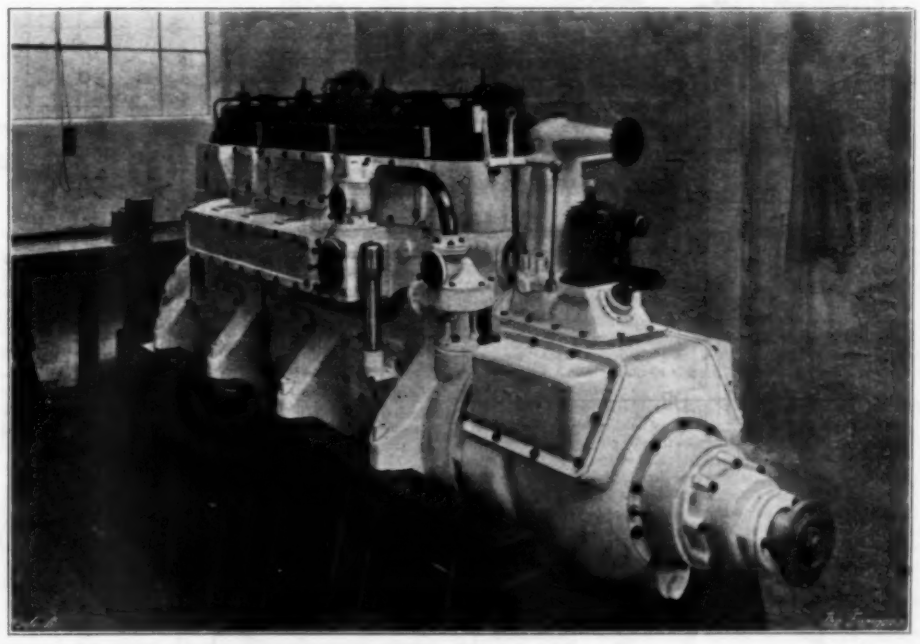


FIG. 4—ENGINE SEEN FROM PORT SIDE

SOME CONSTRUCTIONAL DETAILS.

Two sectional views of the engine, along with a sectional plan and longitudinal sectional elevation of the reversing clutch and brake gear, are shown in the two-page Supplement accompanying this issue. It will be noted from Figs. 2 and 3 that monobloc construction has been adopted, but that the cylinder head, though in one piece, is detachable. The head is complete with overhead valves, high and low-tension ignition, cam shaft and driving gear, and air pump. The other main parts of the engine are the governor, the circulating water and bilge pumps, and the self-contained reversing gear along with the starting engine and gearing, which is built on to the gear casing. Before describing these parts in detail it may be stated that although designed for an output of 90 horse-power the engine is rated nominally at 80 brake horse-power when running at 800 revolutions per minute. There are six cylinders, each 5½in. bore, with a piston stroke of 7in.

Crank Case.—Taking first the crank case, this is made of light cast iron, and in the upper part are formed the water jackets around the cylinder liners, which space is further ported to receive the inlet and exhaust passages, which correspond to similar openings in the cylinder head. The lower part carries the four main crank shaft bearings, and the casing extends downward below these bearings to form an oil well, the large opening at the bottom being of such a size as to admit the crank shaft. This opening is closed by a light ribbed steel sump plate. The four main bearing webs are extended in box formation outside the main crank case, and form rigid bearers for the whole engine and gear. At the forward and aft ends the casing is carried round in a complete circular sweep, and is flanged to receive the end cover for the capstan drive mechanism and the reversing gear casing respectively. Three large inspection doors are provided on each side of the casing, these doors being of such a size that if required, the piston and connecting-rods may be withdrawn through them.

Cylinder Liners.—The cylinder liners are removable, and are made from special liner metal, bored to 5½in. diameter and finished to size by grinding. They are supported at the upper part by a flanged portion fitting into the entablature, while a supporting ring with two rubber jointing rings forms a water seal at a distance of about half-way down the liner. The lower part of the liner extends deep into the casing, and this

has proved an important feature in the design, reducing oil splash and obviating any need for oil baffles.

Crank Shaft.—As will be seen from the drawings we reproduce, the crank shaft is robust in design, with four main bearings 3in. diameter by 5in. long, and crank pins 3in. in diameter and 4in. long, the centre and outer crank pin being specially shaped to assist in balancing the shaft. All bearings are ground to size, and the shaft itself is made from 3 per cent. heat-treated nickel steel.

Main Bearings.—All main bearings have bronze shells white metal lined with specially arranged oil grooves, while the connecting-rods are light forgings with four bolts on the bottom ends, special fitted steel bolts being used. The top end bearing is in bronze and is pressed into place.

Pistons.—Special light iron pistons having three piston rings, the bottom ring acting as a scraper, are used. The piston skirt is cast clear of the gudgeon pin boss and oil grooves and holes are arranged so that the oil may be distributed over the essential bearing surfaces. The gudgeon pins are hollow, and provision is made for splash lubrication.

Cylinder Head.—Referring to the cylinder head, sectional drawings showing the arrangement of ports are given in the left-hand bottom corner of Fig. 7. This part is also made of a high-grade cast iron, and for constructional advantages it is formed longitudinally of three sections, the head proper and the two end boxes, these parts being permanently jointed and machined together. Through the starboard side of each combustion chamber is arranged a passage for the igniter, which opens out into a recess covering two plugs. The cables supplying current to the plugs are led from the top side of the head through gland tubes into this recess. On the starboard side—see Figs. 2 and 3—are three covers giving access to the igniters and ignition plugs, while on the port side—see Fig. 4—similar covers give access to the water jackets.

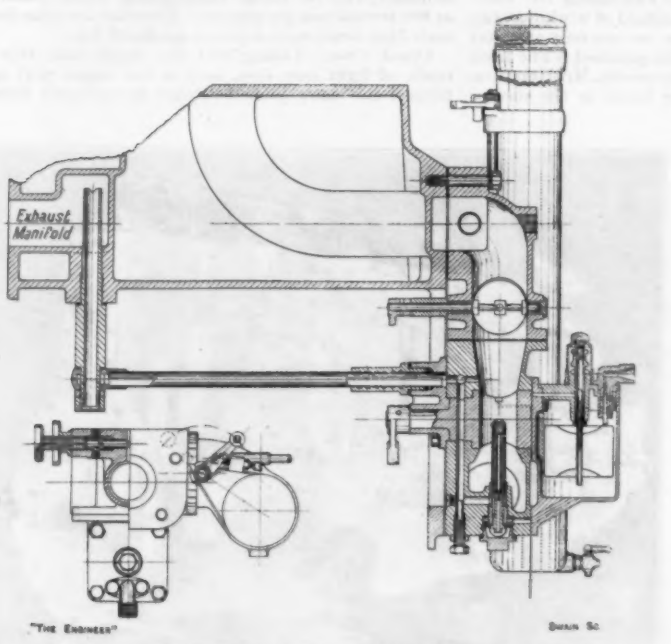


FIG. 5—SECTION THROUGH CARBURETTER

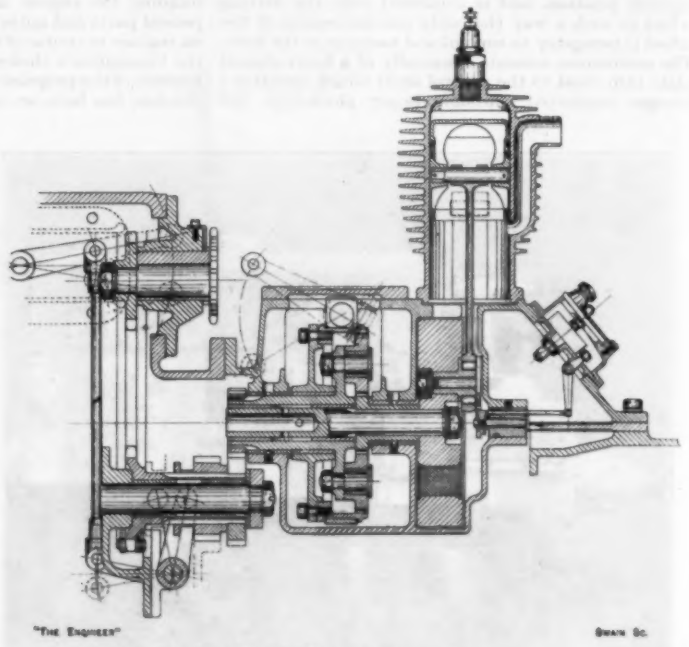


FIG. 6—STARTING MOTOR AND REDUCING GEAR

Referring again to Fig. 3, it will be noted that on the top of the cylinder head is arranged the whole of the valve and ignition operating and control mechanism, also the air pump for supplying pressure to the petrol tanks.

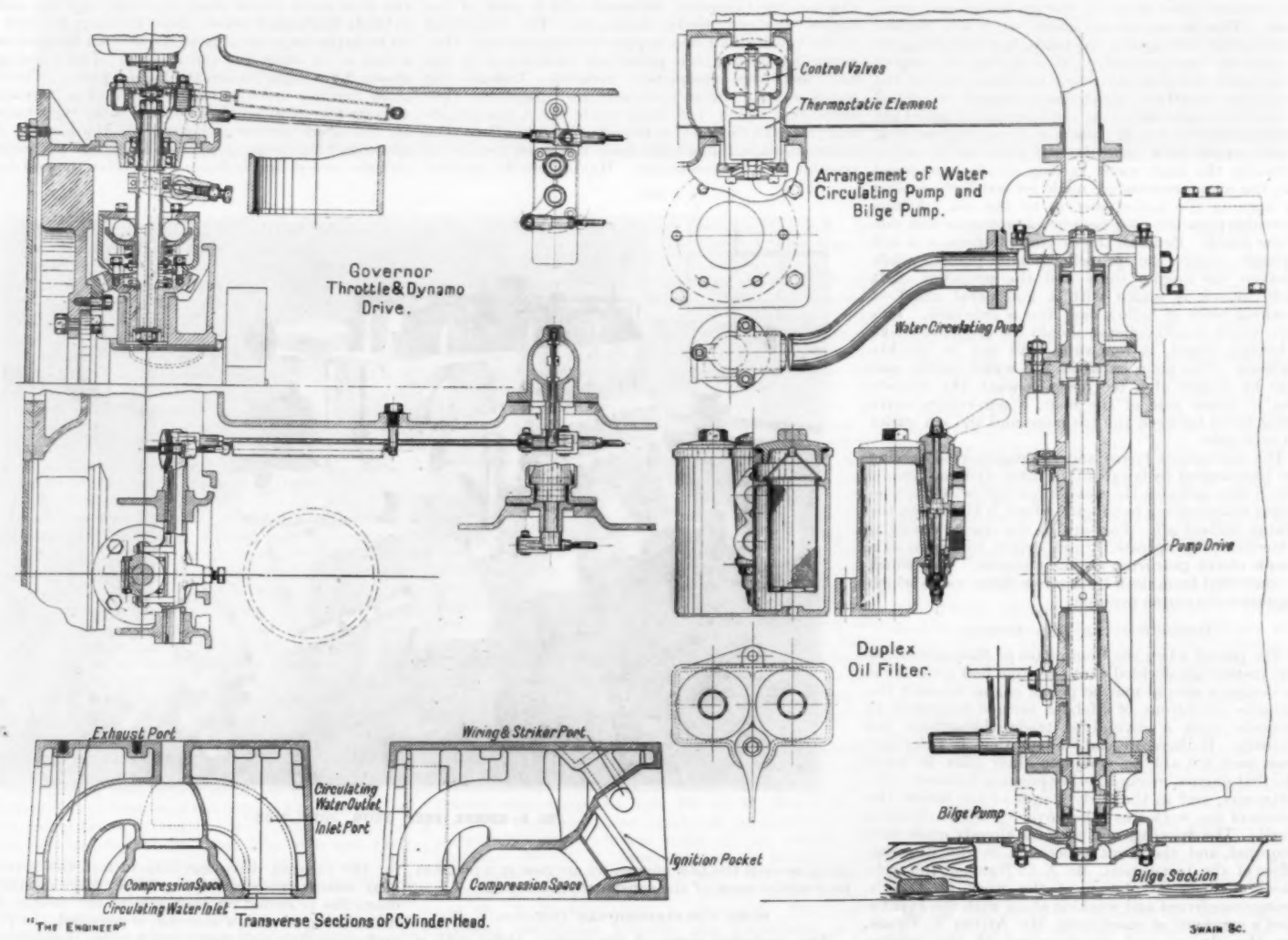


FIG. 7—CYLINDER PORTS AND DETAILS OF GOVERNOR, PUMPS AND OIL FILTER

Cam Shaft.—The cam shaft is designed in one piece with the cams, and is made from Ubas steel case-hardened and ground, the bearings carrying it being 1¼in. in diameter and four in number, attached directly to the cylinder head. Manganese bronze valve levers operate the valves, and are arranged

immediately below the cam shaft; supplementary brackets carry the low-tension ignition cam shaft, which is in the form of a hollow steel tube, and carries six small cams which engage the strikers of the low-tension plugs. The main cam shaft is driven through gear wheels from the crank shaft. At this point it is convenient to refer to the cooling water distribution.

Water Distribution.—Water is conveyed to the main cylinder head through spigot bushes with a rubber ring joint, which is designed so as to isolate the main jointing from contact with the circulating water; by suitably proportioning the size of these spigot bushes according to their place in the cooling system a very even temperature distribution has been attained throughout the engine. The cylinder head is held down to the crank case by thirty-six bolts ¼in. diameter, which are fitted and provided with a fine B.S.A. thread.

Cylinder Head Cover.—This is a light aluminium casting, and—as shown in Fig. 2—it covers the whole mechanism contained on the cylinder head. The lower face of the cover is grooved, and with an oil-proof rubber ring makes a joint with the head, the cover being pulled down by four hand screws on to the cam shaft bearing top. These screws also jack up the cover and enable the joint to be quickly broken when removing the cover. This operation can be accomplished in a few minutes, the only part requiring removal being the cable driving the revolution counter.

Valves.—Mention may be made of the exhaust and inlet valves, made from heat-treated cobalt chrome steel. They have stems of large diameter, 45 deg. faces, and are kept on to the valve faces by right and left-hand springs placed concentrically. The valves themselves are interchangeable. Access to the valves can be obtained through the large igniter ports.

Ignition Systems.—Both low-tension and high-tension systems are fitted, the former being considered as the primary system, and the latter as a stand-by, although they can be operated together. The igniter drive of the low-tension system is operated through helical gears from the cam shaft, and provision is made for timing. The igniter body carries both the high-tension plug and the low-tension mechanically operated igniter, and it is secured to the cylinder head by three bolts and a metal-to-metal joint. The ignition leads and bus-bars for both systems are entirely insulated, and as far as the ignition system is concerned, the engine is not only spray proof but is submersible. For the high-tension system a special distributor and six Delco coils are arranged. An 8-volt current is taken from the bus-bar through the contact breaker and distributor, and is led to independent high-tension coils serving each cylinder. The coils are situated on the cylinder head under the top cover, and the high-tension cables are of minimum length. The cable has been specially made, and is stated to act perfectly when soaked in either hot water or oil.

Governor and Dynamo Drive.—The drawings reproduced in Fig. 5 illustrate the governor and throttle gear. The governor is interesting as regards design, the centrifugal action of four 1in. steel bearing balls being used. They are kept in position by milled guide slots in the governor cover plate. The arrangement of throttle controls is shown. The duty of the governor is to regulate the speed of the engine at 950 revolutions and within a permanent variation of 3 per cent. The dynamo is a Lucas B 418 machine of the plain shunt type delivering a current of about 10 ampères at a pressure of 12 volts. It provides current for ignition, lighting and battery charging.

Carburetters.—The carburetter arrangement is illustrated in section in Fig. 6. Each carburetter serves three cylinders and is of the 40 mm. Solex type, the jet chamber being warmed by admitting hot gases from the exhaust.

Starting Motor.—The mechanical starting of the main engine is accomplished by a small air-cooled cycle motor capable of developing about 3 brake horse-power at 3000 revolutions. The self-contained arrangement of epicyclic reducing gear and engaging gear is shown in Fig. 6. This engine was bought as a separate complete unit, and certain alterations were made in order to equip it for its work. It is, perhaps, rather small in power, but it is only required when the engine has been standing over long periods; at other times the main engine starts easily by hand.

Circulating and Bilge Pumps.—We illustrate in Fig. 7 these pumps and the method in which they are driven. It will be seen that the drive is from a central spiral gear to both pump shafts. The design is so carried that the pump may be removed as an entire unit without disturbing the permanent drive. The circulating water pump deals with 25 gallons of water per minute against a head of 35ft., and it works in conjunction with a thermostatic element which is attached to a controlling valve and maintains the desired temperature in the cylinder jackets. When the engine is cold or on light load the water is short-circuited and the temperature quickly increases. The bilge pump is of similar design and capacity to the circulating pump, and it is placed at the lowest part of the boat, and is in continuous operation when the engine is running.

Lubrication.—The lubrication system is combined pressure feed and splash. In the pressure system about 10 gallons of oil are retained in the sump and circulated. A section of the duplex oil filter is shown in Fig. 7. An oil-filling vent with a 3in. screwed cap is provided on the engine casing, and also breather pipes, which may be hermetically sealed by half a turn of the cowl. These are illustrated in Figs. 2 and 3.

Reversing and Clutch Gear.—A description of the engine is not complete without reference to these parts, which may be studied from the drawings reproduced in our Supplement. The keynote of the gear is the robust design and ample bearing surface of all working parts, such as gears, and the care which has been taken to ensure continuous and efficient lubrication. The clutch is of the plate type with seven $^{3}/_{16}$in. plates alternately of bronze and steel, forced together by six dogs. The plates are arranged with specially formed oil grooves on each side which clear away the oil and allow the drive to be taken up without slip, jolt or jar. Attention may be called to the floating arrangement of the locomotive type brake shoes which grip the epicyclic drum and thereby reverse the motion of the propeller shaft. The control wheel is splined on its shaft, and it may be adjusted from the outside of the casing. During the preliminary tests of the reversing gear it was found that more clearance was needed in the gear bushes. It was given and the clutch has run with entire satisfaction ever since.

TRIALS AND RESULTS.

In designing the new engine it was taken as an axiom that if a thing is made thoroughly well and made from the very best material for the purpose, provided efficient lubrication and protection is given, the maximum service will be obtained with the minimum of wear and attention. This explains some of the features of the engine, and is not wholly unconnected with its satisfactory performance. With regard to fuel consumption, when running at normal cruising speed about 5 gallons of petrol per hour are used, the engine developing about 60 horse-power at a boat speed of nearly 7.9 knots. When running at a full speed, 8.4 knots, and developing 90 horse-power, about 8½ gallons of petrol per hour are used. The weight of the engine complete with all accessories is 7 cwt. It is proposed to fit similar machinery in all future motor lifeboats, of which six are under construction, and another eight will shortly be laid down. With this end in view the parts have been made completely interchangeable, and a large number of machining jigs have been made. The cost of the engine manufactured under these conditions is, it is stated, not excessive considering the workmanship and the material used. Although a petrol engine, the use of heavier fuels and possible future Diesel developments have not been overlooked in the design.

The Committee of Management and the technical staff of the Royal Lifeboat Institution are to be congratulated on the initiative shown in introducing a new class of engine, and it may be that in seeking to meet their own special requirements they have also contributed something to the broader development of marine motor design.

MAINLY with the purpose of diminishing the still heavy ranks of the unemployed, the new Italian Government has decided to proceed with the greater part of the extensive public works which were projected by the Bonomi *regime*, but which were stopped when the latter Government went out of office. Notwithstanding the expressed intention of the Mussolini administration to save every centesimo of expenditure possible, it is found imperative to lay out at least £10,000,000 (nearly 1,000,000,000 lire) upon public works, most of which have long been designed and ready to be commenced. They include port extensions at Genoa, Naples, Palermo and Spezia, at the first three of which ports considerable progress had already been made.

Reclamation Plant and its Operation.*

VERY little literature appears to be extant on the subject of reclamation of land by sand pumping, although a good deal has been written about the dredging side. This method was apparently first started in Holland, where bucket-dredgers discharged their spoil into containers or cylinders, there admixture with water took place, a pump then forcing the mixture on to the land to be reclaimed. The pipe-line was of wood, the pipes being made of parallel staves hooped together and jointed to each other by means of leather bands.

Later, at the widening of the Kiel Canal, bucket-dredgers discharged into hopper-barges, which, when loaded, were towed alongside the pumping plant where their contents, mixed with water, were sucked out and delivered on shore. No very long distances were attempted, as the operations were in this case primarily for the disposal of spoil. Here the shore pipe-line was of steel with flanged connections.

In more recent times bucket-dredgers have, to a great extent, been superseded by the suction type, which, since the invention of the cutter and of the draghead with hydraulic jets, is capable of dealing with spoil which was formerly considered unsuitable for any but bucket- or grab-dredgers. The great advantage of the draghead is that while it can deal with muddy or clay bottoms, it does not lift stones or other substances which are likely to damage the reclamation pumps, these portions of the spoil being left behind on the newly formed bottom at sufficient depths to render them harmless to navigation.

The method of pumping direct from the bottom into a pipe-line floated on pontoons has often been employed; this allows of the dredger being moved about over a considerable area without disconnecting, but not sufficient to permit of a draghead being used. This system was used when dredging the harbour of Bombay, where the dredgers Jinga and Kalu, fitted with cutters, delivered spoil through

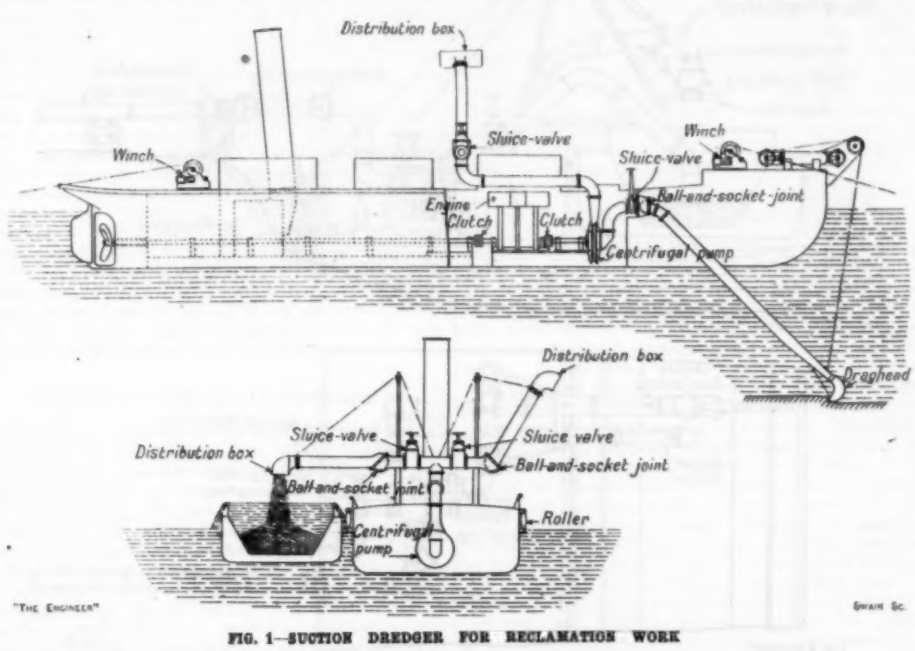


FIG. 1—SUCTION DREDGER FOR RECLAMATION WORK

floating pipe-lines either on shore, or into shallow water for making land. It was also employed at Rangoon, where spoil was delivered behind a training wall into from 10ft. to 70ft. of water through 42in. pipes, for the purpose of filling in the area enclosed by the wall.

A modern plant capable of sending the spoil a mile or more inland generally consists of a dredger fitted with a draghead and hydraulic jets, a tug, three or four hopper-barges, and a reclamation vessel with its shore connections and steel pipe-line.

Dredger.—The dredger—Fig. 1—should be of as light a draught as possible so as to be able to work over the shallowest parts to be dredged. It should be self-propelling so that moves may be made from one position to another, or for coaling and repairs, without the aid of tugs. Separate propelling engines are not necessary, as one set can be arranged to be coupled either to the pump or to the propeller-shaft as required by means of suitable clutches. A cutter may be fitted for use when rocks or very hard clay are encountered, but for ordinary spoil other than this the draghead will be found sufficient. The suction pipes are generally worked by a hydraulic engine, the delivery pipes by steam, or by hand in smaller vessels.

Reclamation Vessel.—This vessel—Fig. 2—is usually fitted with two sand pumps in series, but either should be arranged to draw from the barge, or deliver on shore, by manipulating sluice-valves, so that for short distances up to about 1200ft. one pump only may be used. Each of these pumps is driven by a separate set of engines, generally of the triple-expansion inverted marine type. The vessel need not be self-propelling, but this might be advantageous if the work is situated at a long distance by sea from the builder's yard, as the cost of these engines might well be less than the cost of towage and extra insurance.

Shore Connections.—The connection between the pump discharge and the shore pipe-line is effected by means of a "floating" length of pipe, that is, a short length of pipe with a ball-and-socket joint at each end. This allows for the rise and fall of the tide, of variations in the draught, and the heeling of the vessel when the suction pipes are raised

* Extracts from a paper read before the Institution of Mechanical Engineers on December 15th by Mr. Gascoigne Lumley.

or lowered. The inner ball-and-socket joint is coupled to a telescopic piece or expansion joint which takes up the end play due to the radial motion of the "floating" length. From there onwards the pipe line may be supported by trestles, sand bags, or banked-up earth, the line gradually falling to the point of discharge.

Pipe Line.—At a certain distance inshore it is usual to insert a breeches piece, containing a flap valve, which directs the stream of spoil to either branch. This is done to enable the length or direction of the shore line to be altered without interruping pumping operations, as by throwing over the valve the flow of the spoil can be diverted to another branch which is laid to the fresh area to be reclaimed, and while that area is being filled in the length formerly being pumped through can be uncoupled and relaid, or merely lengthened. With pipes up to 27in. to 30in. in diameter it will readily be understood that several days may be required to relay a thousand feet of pipe. Changes of direction are effected by means of spring bends; right-angled turns should be avoided, as they cause considerable loss of velocity.

When working, it is necessary to lengthen the pipe line very frequently, two or three lengths being added at a time so as to maintain the uniform level indicated by the pegs. If this were not done, much extra labour would be required to level up the areas afterwards, in addition to that necessary for filling up the craters which are formed by the sand and water issuing from the orifice of the pipe.

Wear and Tear.—As may be imagined, very considerable wear and tear are caused by the passage of sand and water through the pumps and pipes. A plentiful supply of spare parts is, therefore, very essential. Usually the pumps are lined with steel plates, attached to the casings by counter sunk headed bolts; as these lining plates wear away they can be renewed. Sometimes smaller cast iron sections are used, especially at the places where most wear takes place. The advantage of these is that they can be cast exactly the size and shape required, they are harder and so last longer and are cheaper to replace.

The impeller blades also wear very quickly. If ordinary open impellers are used, renewals are easily effected, but the type is more liable to damage by obstructions, such as pieces of old anchor chain, shackles and other articles dropped from ships and lifted from the bottom by the dredger's pumps. Shrouded impellers last longer and are not so liable to breakage, but when they are worn new ones are required, as they can seldom be fitted with new blades, owing to grooving action by sand. Other parts liable to excessive wear are the throat pieces of the pumps and the cast iron bends at the suction and delivery sides.

Such vessels as we have described are very expensive to maintain, repairs often being much the heaviest item in the cost of the operations. Spare parts of all kinds, often of a very costly nature, have to be kept in stock in order that work may not be interrupted by the breakage or unduly rapid wear of any portion of the plant. Such items as impellers, lining plates, ball-and-socket joints, impeller shafts, suction pipes and heads, &c., are necessary, as if they were not available work might be held up for considerable periods.

Lagos Plant.—The plant at work in Lagos Harbour, Nigeria, is a good example of a modern reclamation outfit, and does not differ substantially from the foregoing descriptions; from it the observations and results which follow were obtained. The indicated horse-power of the pumping engines of the dredger was about 600, and on the reclamation vessel about 700 indicated horse-power was available for each pump. The delivery pipe was 27in. diameter, and the barges of 1000 tons capacity.

Considerable variation in the kind of spoil was experienced, from very coarse sand, which sank to the bottom of the hoppers of the barges almost immediately, to fine sand mixed with clay and mud. When dredging coarse sand a barge load of 1000 tons could be obtained in about twenty minutes, as very little flowed away, but with the clayey mixture most of the clay and some of the fine sand escaped with the surplus water over the coamings. The average time for filling the 1000-ton hopper was about one and a half hours.

When discharging, the reverse conditions obtained. Coarse sand is more difficult to force along a pipe line, and it was found that it settled a good deal, thus decreasing the available area of the pipe, increasing friction, and by lowering the velocity caused more sand to settle. A much weaker mixture had to be pumped, and the sea connections of the pump had to be utilised two or three times during the course of discharging a load in order to clear away the deposited sand by pumping pure water through the pipe line.

With clay and fine sand a barge could be emptied in half the time, the mixture being easily held in suspension with little or no tendency to settle through moderate lengths. A good deal depends on the maintenance of the velocity of flow through the pipes; if a good head of steam can be kept up, and the pumps worked to their full capacity, better work can be done. When steam was down it was found to be advisable to shut down and allow it to rise, rather than continue with insufficient pressure.

The length of the pipe line also affects the speed of working; with short lengths much stronger mixtures can be pumped, and the barges emptied in much shorter times than with longer lengths. It was found that with the power available the limit to which spoil could be pumped was about 4500ft. At that length the fuel consumption was nearly 4 tons of coal per barge load, and made work at that distance too costly. Of course, this limit was reached earlier with coarse sand than with spoil of a finer nature. Also, at about 4300ft. the pumping engines were showing signs of overload, while the delivery head fluctuated considerably, showing that the pumps were churning. Friction destroys the velocity of the mixture being pumped, sand is deposited in the pipes and is dragged along the bottom by the moving mixture, tending to increase the friction and decrease the area still more. As the load approaches completion this deposit accumulates to such an extent as to cause a considerable rise in the delivery pressure to show on the gauge, the difference being as much as 20ft. to 40ft. of head—according to the length of pipe line—between the beginning and end of a load.

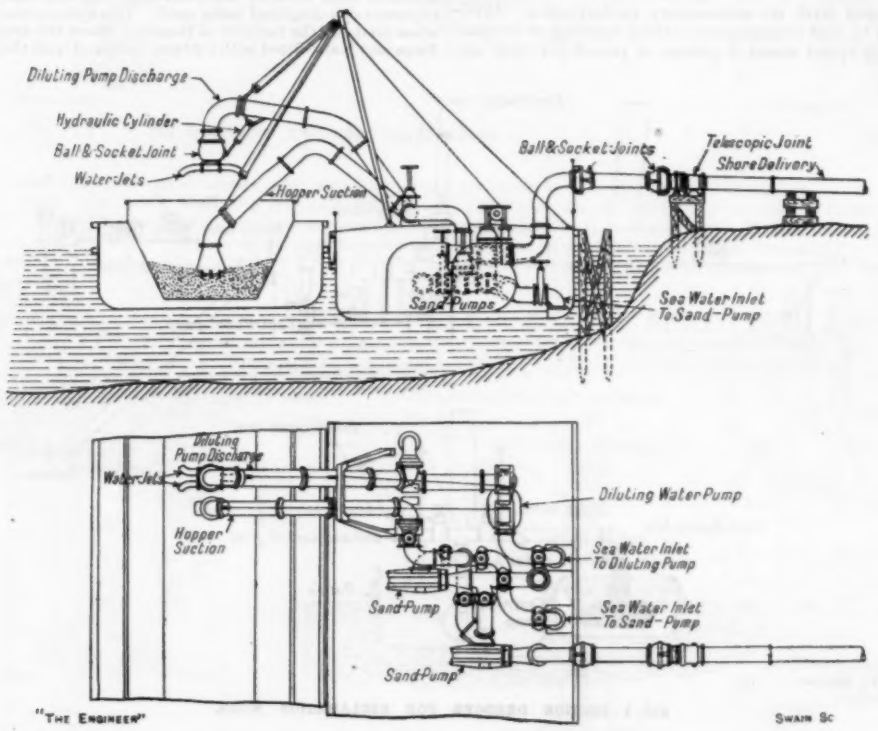


FIG. 2—PUMPING SAND FROM HOPPER FOR RECLAMATION

Design and Tests.—The designer of plant of this nature is somewhat handicapped in that it is seldom a test can be made with actual working conditions under his own observation. Even if areas were available for reclamation tests, the expense of laying several thousand feet of pipe line and its connections would be prohibitive, consequently he has to be content with such trials as can be made without the pipe line.

Generally, working conditions are simulated by throttling the discharge orifice of the pump until the pressure shown on the gauge corresponds with the calculated head of a pipe line of known length. This method is sufficient to prove that the plant is capable of pumping against that head, but does not show the effects of the gradually increasing frictional resistance of the actual pipe line due to the deposition of sand, the increase in the strength of the mixture due to slight leaks in the joints of the pipes, which occur however carefully the line has been laid, nor the extra resistance due to bends. Also at the initial test described the pumps are working at their maximum efficiency, which would drop considerably after three months' wear. Under working conditions, therefore, only about 75 per cent. of the results obtained during such trials can be expected, and if this is attained, the plant may be considered as satisfactory.

Operating.—With single crews, working during the day only, it is usual to pump five days a week, Saturdays being reserved for coaling, watering, and for examination of working parts, minor and current overhauls, &c.

At the end of every three months' work, it is necessary to close down for about ten days for boiler cleaning, relining of pumps where necessary, and such general examination of all parts likely to suffer by the passage of sand. During this time opportunity should be taken to overhaul the pipe line, rejointing where leaks have been marked. Allowing about ten days for public holidays, it will thus be seen that it is possible to pump for about 220 days in a year.

The Lagos plant can deal with an average of eight barge loads of 1000 tons in a day, so that a year's work would account for about 1,760,000 tons, or 1,220,000 cubic yards, equivalent to 126 acres raised to a mean height, above its former level, of 6ft. The value of the land thus reclaimed may go a long way towards paying for the cost of dredging the harbour, which during this period, if silting up is not occurring, will have been deepened by the same amount as the land has been raised.

It is not advisable to start pumping at less than about 300ft. from the shore, unless there is a retaining wall, as at a less distance than this the sand is liable to flow back into the water and may silt up the berth occupied by the reclamation vessel, with the result that it may ground or be in such shallow water as to damage the circulating pumps and condensers by sand.

Sometimes if the land is very swampy, it sinks considerably under the load of spoil deposited on it, and causes the harbour bottom near the shore to rise. Frequent soundings should be taken lest the vessel take the ground owing to this cause. Also it is as well, when marking off the working level over an area, to allow for this possible subsidence and so having to undertake additional pumping to maintain the desired level.

Costs.—The cost of dredging depends, of course, like all work, on local conditions, such as the rates of pay for labour, freight on and cost of fuel and stores, &c. In these rapidly-changing times it is difficult to give an absolute figure, as such a figure might easily be quite misleading by the time this paper is read. The relative costs of the different operations, however, may be taken as follows:—

Dredging	0.40
Towage	0.10
Upkeep of barges	0.05
Pumping on shore	0.42
Pipe line	0.03
	1.00

If the spoil were to be dumped in deep water instead of being pumped ashore, using a hopper dredger of similar size, considerable time would have to be allowed for mooring and unmooring and steaming to and from the dumping ground. This would raise the cost per ton of the dredging from two to two and-a half times, according to the distance of the pumping ground from the dredging site, while the output would be proportionately diminished. Working in conjunction with the reclamation vessel, the dredger can pump practically continuously, stopping only to change barges and renew the cut.

Various rates per ton or per cubic yard deposited have been quoted, ranging from about 1.75d. per cubic yard to 4s. 6d. a ton. In some cases the costs include depreciation and capital charges; in others they represent running expenses and repairs only. A larger and more costly plant will show lower working costs, but to a certain extent, these will be discounted by the higher charges for depreciation and interest on capital.

Another item which is not always included is the cost of surveys. When the work is being done by a Government or port authority such surveys would be carried out by the permanent harbour officials, and would not be shown on the cost sheets, but a contractor would have to take them into account, as they are a necessary check on the progress of the work.

ROLLER BEARING PLUMMER BLOCKS.—A new series of plummer blocks, which has just been brought out by John Jardine, Limited, Nottingham, is equipped with roller bearings. The inner race of the bearing is fixed on the shaft by means of a split taper bush, while the outer ring is ground spherically to match a spherical seating in the plummer block. The bearing can thus be adjusted to a nicety along the length of the shaft, while the spherical seating makes it self-aligning. The bearing is made in several sizes, ranging in diameter from 1¼in. to 3¼in.

COMMERCIAL FAIR IN MADAGASCAR.—It is reported from Paris that the first official Madagascan Commercial Fair (samples) is to be held at Antananarivo from August 15th to September 15th, 1923. The Fair will be held under the auspices of the Government of the Colony and British firms will be invited to exhibit. The exhibits are to comprise machines and machinery, oils, metallurgical products, hardware, textiles, china and glassware, foodstuffs, and various general merchandise. Full information concerning the Fair can be obtained from the British Chamber of Commerce at Antananarivo.

INSTITUTION OF MECHANICAL ENGINEERS.—The annual dinner of the Institution of Mechanical Engineers, which was held in the Connaught Rooms on Thursday, December 14th, was attended by an unusual number of members and their friends—a fact which was, no doubt, accounted for to some extent by the occasion being the seventy-fifth anniversary of the foundation of the Institution. After the usual loyal toasts had been honoured, Sir John A. F. Aspinall, past-president, proposed "His Majesty's Forces," to which toast the Rt. Hon. L. S. Amery, First Lord of the Admiralty replied. He pointed out that the Government was helping to relieve unemployment by laying down battleships two by two, and remarked that science and war depended largely upon one another. Lieut.-General Sir Travers E. Clarke, Quartermaster-General to the Forces, also replied. The toast of "Scientific Education" was proposed, in an amusing speech, by Lieut.-Colonel E. Kiteon Clark, member of Council, and was responded to by Mr. W. R. Davis, Technological Branch of the Board of Education, and Sir Thomas H. Holland, Rector, Imperial College of Science and Technology, who urged the necessity for closer co-operation between the Central College and London University. The Rt. Hon. Sir Philip Lloyd-Graeme proposed "The Institution," and promised that the Board of Trade would consult it before making any changes in patent law, while he gave a definite assurance that the trade of the country is now improving. The president, Dr. Hele-Shaw, in replying, said that the Institution now controls all technical education, and suggested the possibility of the Institution's headquarters some day becoming so extensive as to provide lodging for visitors. Mr. W. H. Patchell, vice-president, proposed "The Visitors," for whom response was made by the Hon. Sir Edgar Walton, High Commissioner, Union of South Africa, who said that the Dominions always tried, in spite of the apathy of our manufacturers, to purchase British materials in preference to foreign goods, and warned the Government of the danger of discriminating between the several Dominions.

A Seven-Day Journal.

Protection for Commercial Motor Vehicles.

A STRONG effort is at present being made by the Association of British Motor Manufacturers to secure the protection afforded by the Safeguarding of Industries Act, 1921, for commercial road motor vehicles. The private passenger motor car industry is at present protected against the unrestricted influx of foreign cars by a heavy import duty, and it is urged that the commercial vehicle section of the trade should be afforded similar assistance. The depreciation of the continental exchanges is such, it is stated, that this country is being flooded with German, Italian, and French vehicles and parts thereof, which are being sold at prices below the cost of production in this country, with the result that the industry is being conducted at a loss and employment in it is being seriously curtailed. Taking the 4-ton lorry chassis with tires as an example, the Association's "complaint" to the Board of Trade gives the average retail price in Great Britain of a German vehicle as £350, of an Italian one as £625, and of a French one as £700. Returns received from thirteen British firms show that during this year the average cost of production in this country has been £748. Before the war the number of commercial vehicles imported into this country from abroad was small. In 1919 the number imported and retained amounted to 1484. In 1920 the figure rose to 16,031, and in 1921 fell to 1097. The British industry has not only had to struggle against the importation of low-priced foreign vehicles, but has had to contend to an extent not exceeded by any other industry with the release of Government stocks accumulated during the war.

A Remarkable Marine Collision.

LAST week we noted the occurrence of an accident of a nature probably unprecedented in the history of British railways. To-day we have to record one equally remarkable involving two steamships, a collision between an anchored and a moving vessel, as a result of which the latter foundered. The vessels concerned were the coasting steamer Smerdis, of 1032 tons register, owned by Messrs. Hutchison, of Glasgow, and the City liner City of London, of 8956 tons. The latter vessel was lying at anchor last Saturday night in the Mersey at Liverpool, when, at about 8.30 p.m., in clear weather, the Smerdis, inward bound from Bordeaux with iron ore and general cargo, was carried against her bows and sank in less than five minutes. The Smerdis was steaming at the time at a customary river speed, and was practically cut in two. Accounts differ as to the cause of the accident. According to one report, the Smerdis was swept across the taut cable of the liner, with the result that her bottom was ripped off. According to another account, the City of London was swinging with the tide, but it is not easy to understand how the collision would arise in these circumstances if the vessel were anchored at the bow. It is reported that the pilot of the Smerdis has stated that his vessel was carried by the tide on to the bows of the anchored liner, a statement which suggests that "suction" may have played a part in causing the disaster. Of the nineteen men on board the Smerdis, nine only were rescued alive. The vessel, it is stated, is to be salved immediately.

The Engineers' Who's Who.

WE are glad to notice that the third edition of "Who's Who in Engineering," just published, shows clear evidence that the work is being supported by an ever-increasing number of British engineers the world over. From the modest dimensions of the first volume it has now grown to a book containing over twelve hundred pages. While fresh and valuable sections and classifications have been introduced, the growth in size is chiefly the result of an increase in the number of names in the biographical portion, which now contains over 8000 notices. The editor, Mr. J. E. Sears, Junr., is to be congratulated on providing the engineering profession with a reference work which not only satisfies our legitimate curiosity regarding the present position and antecedents of our fellow-engineers, but which in a hundred different ways is of direct commercial value to all having to do with engineering in any of its branches.

Two Years' Awards to Inventors.

A REPORT covering the proceedings of the Royal Commission on Awards to Inventors during the period from August 1st, 1920, to July 31st, 1922, has just been issued. The Commission sat on ninety days, and dealt with 143 cases, while the Investigating Committee considered 469 claims and gave a personal hearing to eighty-five claimants. In general, according to the report, the Commission disallowed claims submitted by patentees for extra remuneration on patented articles manufactured or supplied by themselves. In general, too, it disallowed claims by those engaged in a Government Department for the express purpose of research and discovery, even although the claimants had incurred grave personal risk in their work or had given their services voluntarily or for a low remuneration. Dealing with the invention of the paravane, the report states that a large sum would have been awarded to Commander Burney but for the fact that he had already received £265,000 by the disposal of the commercial rights of the invention. It is placed on record that Commander Burney's real object in making a claim seems to have been to establish his right to the credit of the invention, and that he had previously expressed his intention of applying any reward received for it to some naval charity. Among the largest awards noted in the report are £48,000 for the "Wasp" and "Dragonfly" aero-engines, £37,000 for Mills bombs, £30,000 for Handley Page aeroplanes, £27,000 for the MacTaggart and Scott submarine control gear, and £20,000 for the B.H.P. aero-engine.

The Therm Inquiry.

THE second sitting of the Board of Trade Committee which is inquiring into the therm as a measure of the sale of gas was held in London on Monday. Dr. C. H. Lander, Deputy Director of the Fuel Research Station, expressed the opinion that the different calorific values declared by the different companies did not cause any disadvantage to the consumer provided the gas appliances were properly adjusted. Mr. C. D. Johnson, of the London County Council, stated that there was no reason to suppose that the increased gas bills for 100 of the Council's schools, the accounts of which he had examined, were the result of the change in the charge basis. The chief cause of public complaint, he thought, arose from the fact that the introduction of the therm coincided with the granting of permission to increase the standard price in order to meet the higher costs of production then prevailing. Representatives of the Sheffield Gas Consumers' Association expressed approval of the therm, but complained that the recommendations of the Fuel Research Board in the matter had not been fully carried out. Other witnesses urged that the gas supplied by the different companies in London should be of uniform quality, and that the bills should invariably show the consumption both in therms and in cubic feet.

The F.B.I. and the Government.

THE annual meeting of the Federation of British Industries, on Thursday of last week, was marked by a distinctly guarded review of the present condition of industry by the retiring President, Colonel O. C. Armstrong. In the course of his remarks he dwelt upon the burdens imposed on industry by taxation, foreign competition and tariff barriers. Sir Max Muspratt, in proposing a vote of thanks to the retiring President, struck a somewhat more optimistic note, for in his opinion the outlook as regards industrial peace between employers and employed has never been brighter than at the present moment, a factor affording intangible but very valuable help in the troubles with which industry has still to struggle. Subsequently the meeting authorised the transmission to the Prime Minister of a manifesto expressing its views on the best manner in which the Government can help to restore prosperity to the country's industries. This manifesto laid it down that the Government's policy ought to be the removal of impediments which are delaying the revival of trade rather than affording active assistance, which might degenerate into harmful interference. The Government was urged to lessen the crushing burden of taxation, to reduce its expenditure in order that the Budget might be balanced without further borrowing, to economise in the administration of the country's educational system, to abandon all remaining forms of Government competition with private traders, to promote the conclusion of commercial treaties with foreign countries, and to devote close attention to other matters, such as the rating of machinery, postal charges, merchandise marks and public contracts.

Vulcanised Fibre.

IN the Journal for June 9th we reported the appointment by the Board of Trade of a Committee to inquire into the complaint submitted by the British Electrical and Allied Manufacturers' Association to the effect that vulcanised fibre manufactured in the United States was being sold in this country at prices below the cost of production. The Committee has now presented its report, and finds that no case has been made out for the imposition of an import duty on vulcanised fibre under Part II. of the Safeguarding of Industries Act. The complaint was made by the Association on behalf of Sutcliffe, Limited, of Manchester. An agreement between importers and certain British manufacturers came into force last February whereby the minimum selling price of the fibre was fixed at 1s. 7d. per pound. Messrs. Sutcliffe were not parties to that agreement, nor did they object to the price fixed by it. They complained, however, that the agreement did not cover more than 25 per cent. of the imported fibre, and, moreover, that it was being evaded. The Committee, however, found that no serious evasion was taking place, and that the price named in the agreement was very fairly the minimum at which the bulk of American fibre had been sold in this country since last February. It therefore held that the Association's case had not been established.

The Broadcasting Company.

LAST Friday the British Broadcasting Company, Limited, was registered as a public company with a nominal capital of 100,000 shares of £1 each, bearing a fixed cumulative dividend of 7½ per cent. per annum. Without the previous written consent of the Postmaster-General the board of the company is not to allot more than 60,006 shares in the initial capital among the Marconi, Metropolitan-Vickers, Radio Communication, British Thomson-Houston, General Electric, and Western Electric Companies. It is further required to allot shares up to a total of 39,994 to any other *bonâ fide* British manufacturers of wireless apparatus. No such other applicant, however, is to receive more than 10,000 shares. The chairman of directors of the new company is Lord Gainford. The constituent companies, we learn, have pooled all their patents for transmission, while as regards patents for reception an arrangement has been made with the object of avoiding litigation whereunder licences will be granted by the Marconi Company for the manufacture of receiving apparatus for the specific purpose of the broadcasting scheme. The permanent broadcasting stations, it is expected, will be completed at an early date.

The New Battleships.

SOME comment has been made in connection with the fact that whereas the Clyde received contracts for three out of the four warships which were to be built a year ago, it has been denied all share in the work of building the two new battleships now sanctioned except as regards a portion of the armament. It has been officially stated in this connection that the tenders accepted were the two lowest submitted, and that those received from the Clyde firms were higher than any of the rest. Speaking in Glasgow a few days ago, Lord Maclay referred to the Clyde's loss and the disappointment which it has caused in Glasgow and the neighbourhood. According to information which he had received, he said, the Clyde shipyard workers' efficiency, as measured by output, was at least ten per cent. less than that of the workers in some other centres, a fact which, if true, was in itself sufficient to explain why the Clyde yards had been passed over in the award of the contracts. Lord Maclay's remark has excited great indignation not only among the Clyde workmen, but also on the part of the shipyard employers. Sir Thomas Bell, of John Brown and Co., has declared that the Clyde's reputation for workers and workmanship has never been higher than it is to-day.

A Textile Machinery Combine.

IT is rumoured in Manchester that a big combination of firms manufacturing textile machinery may possibly take place in the near future. Among the firms which, it is said, are likely to combine are Platt Brothers and Asa Lees and Co., both of Oldham; Howard and Bullroughs, of Accrington; Dobson and Barlows, of Bolton; and Hetherington and Sons, of Manchester. The capital of the combination would, it is reported, be at least £12,000,000. Some fear is expressed in cotton trade circles that the scheme, if carried out, would result in the elimination of competition and a consequent increase in the prices charged for textile machinery.

The British Empire Exhibition.

THE major portion of the criticism recently levelled against the Executive Council of the British Empire Exhibition would, it seems, to have been satisfactorily replied to and set at rest by the authoritative pronouncement made by the Duke of Devonshire in a communication to Sir Joseph Cook, High Commissioner for Australia. As chairman of the Executive Council his Grace has stated that provision will be made in all contracts, and in every other way possible, for Empire materials only to be used in the construction of the exhibition buildings, and for Empire products only to be used in the restaurants. No exception, he adds, will be made unless it is certified by the British authorities and the Dominion representatives that such Empire products are not available.

A Study of Air-Steam Mixtures.*

By L. A. WILSON and C. R. RICHARDS.

Purposes of Tests.—The purpose in operating a reciprocating engine with a working medium composed of a mixture of air and steam was to determine the possible advantages in thermal efficiency resulting from the use of such mixtures, having different proportions of the two components and with different initial temperatures of the compressed air. As a basis for the comparison of results it was necessary to determine the engine economy when using steam alone and air alone at various initial temperatures.

Tests with Steam.—The tests with steam were made to determine the steam consumption at different loads. A gauge pressure of 100 lb. per square inch was used. The quality of the steam was determined by means of a throttling calorimeter situated just above the throttle valve. All observations and indicator diagrams were

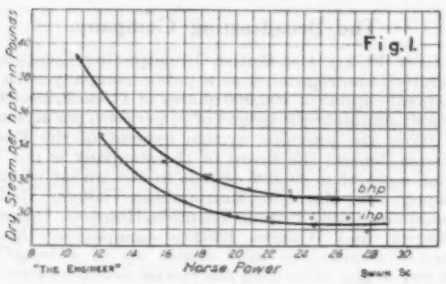


FIG. 1.—*Steam Consumption per Horse-power per Hour, using Steam alone.*

taken every five minutes during thirty-minute tests. The following data were recorded :—

(1) Net brake load in pounds.
(2) Revolutions per minute, by the revolution counter.
(3) Pressure at throttle (kept constant) in pounds per square inch.
(4) Temperature at throttle in degrees Fahrenheit.
(5) Temperature in steam chest in degrees Fahrenheit.
(6) Temperature of engine-room in degrees Fahrenheit.
(7) Temperature in exhaust pipe in degrees Fahrenheit.
(8) Pressure in exhaust pipe in pounds per square inch.
(9) Temperature in calorimeter in degrees Fahrenheit.
(10) Temperature of condensed steam in degrees Fahrenheit.
(11) Weight of condensed steam in pounds.
(12) Barometer height in inches of mercury.

The results of the steam tests are represented graphically by the curves in Fig. 1. The lowest steam consumption per indicated horse-power per hour attained in this series of tests was 28.9 lb.; in similar tests reported in Bulletin No. 130 the lowest consumption was 27.1 lb.

Tests with Air.—The tests with air were made to determine the air consumption at different loads for different initial air temperatures. The water vapour in the air froze in all tests made with air which had a temperature of 300 deg. Fah. or less. In every test in which the exhaust temperature was below 32 deg. Fah. the exhaust valve clogged

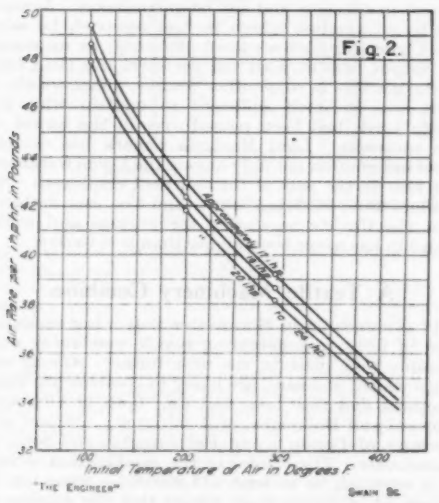


FIG. 2.—*Air Consumption per Indicated Horse-power per Hour for Given Horse-power for Different Initial Temperatures, using Air alone.*

with ice. When the back pressure caused by the stoppage became appreciable the test was terminated.

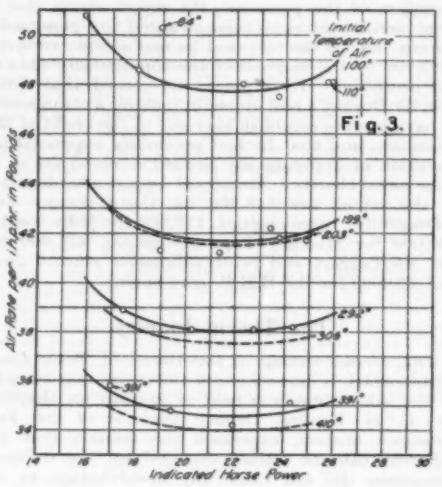
All tests were started with the engine comparatively warm, and only data and indicator diagrams secured during the last thirty minutes of a test were used. This practice was adopted to obtain data representative of normal running conditions. It was found, however, that owing to increasing friction in the engine caused by the formation of ice and from less effective lubrication, the mechanical efficiency decreased as the test progressed. It was impossible to get satisfactory equilibrium conditions with air alone except by heating the air to an initial temperature sufficient to prevent the exhaust temperature falling below 32 deg. Fah. By taking indicator diagrams and Venturi meter data simultaneously at stated intervals, under the conditions named, and computing the air consumption per indicated horse-power per hour, this was found to remain practically constant throughout the test.

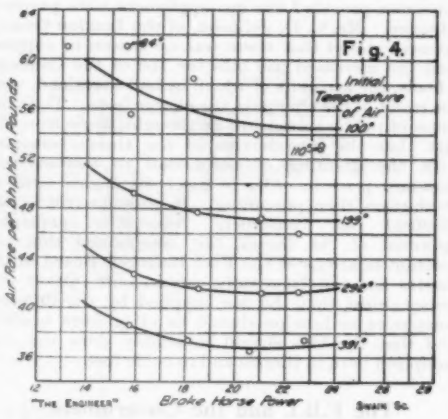
* From Bulletin No. 131 of the Engineering Experiment Station, University of Illinois, Urbana.

The air consumption per brake horse-power per hour varied for the reasons already stated ; therefore, for these tests it has been averaged for the thirty-minute period.

An unsuccessful attempt was made to overcome lubrication difficulties by using alcohol and graphite. A mixture of gas engine oil and graphite seemed to give the best lubrication results. Were it practicable to free the air from moisture before admitting it to a reciprocating engine, there would probably be little mechanical difficulty in using it expansively, but with such large quantities of air as were used in these tests, no convenient nor simple means for drying the air could be devised.

The test with air were made at several loads with an





FIGS. 3 *and* 4.—*Air Consumption per Indicated and per Brake Horse-power per Hour for Different Initial Temperatures, using Air alone.*

initial gauge pressure of 100 lb. per square inch at the throttle, and with initial temperatures of approximately 100 deg., 200 deg., 300 deg., and 400 deg. Fah. respectively at the entrance to the mixing chamber. When air was used the engine would not carry overloads satisfactorily, probably because of the small size of the supply pipe and the consequent drop in pressure accompanying a late cut-off. The conditions of operation were such as to prevent the formation of a loop at the toe of the indicator diagram : hence complete expansion to back pressure determined the limit of earliest cut-off.

The condenser was disconnected during the air tests, the air being exhausted directly into the room. A pentane thermometer reading in degrees Centigrade was placed in a mercury well as near the cylinder as possible to indicate the exhaust temperature. Owing to the proximity of steam pipes and the heat of the surrounding atmosphere the lower temperatures recorded are probably incorrect. It should also be noted that there was a tendency for snow and ice to accumulate in the exhaust pipe around the thermometer cup, but by pounding occasionally on the outside of the pipe these obstructions were dislodged.

The air pressure was set at 100 lb. per square inch gauge and kept constant by regulating the pressure of the steam operating the compressor. A preliminary run of two or three hours' duration was necessary to heat the pipes and enable adjustments of apparatus, particularly of the reheater, to be made ; during the run sufficient steam was allowed to mix with the air to prevent freezing. Between runs it was necessary to pass steam through the engine to thaw the ice before making adjustments for the succeeding run. Before a test was started the steam was shut off by closing the steam valve tightly with a wrench, in order to eliminate the possibility of leakage, since the introduction of a very small quantity of steam would lead to erroneous results.

Readings were secured every five minutes, the Venturi meter data and indicator cards being taken as nearly simultaneously as possible. The readings were as follows :

(1) Net brake load in pounds.
(2) Revolutions per minute (by the revolution counter).
(3) Pressure at throttle (kept constant) in pounds per square inch.
(4) Temperature at throttle in degrees Fahrenheit.
(5) Temperature in steam chest in degrees Fahrenheit.
(6) Temperature of engine-room in degrees Fahrenheit.
(7) Temperature in exhaust pipe in degrees Centigrade (converted to Fahrenheit on data sheet).
(8) Pressure in exhaust pipe in pounds per square inch.
(9) Temperature of air entering Venturi meter in degrees Fahrenheit.
(10) Pressure of air entering Venturi meter in pounds per square inch.
(11) Venturi head, by manometer, in inches of mercury.
(12) Temperature of air entering heater in degrees Fahrenheit.
(13) Temperature of air entering mixing chamber in degrees Fahrenheit.
(14) Barometer height in inches of mercury.

The results of the air tests are shown graphically by the curves in Figs. 2, 3, and 4. It will be noted that some of the points do not fall upon the curves selected, for which fact the following explanation is offered. Variations in the initial air temperature existed, since it was impossible always to keep this temperature constant. For some tests the average temperature fell above or below the desired value, in which cases the curve was made to pass at the proper distance from the point recorded. Three such points appear on the curve which records temperature of 100 deg. Fah. The points for air at 200 deg. are somewhat scattered ; hence the curve was drawn to make it consistent with the three other curves.

The curves show that with compressed air the greatest economy was secured at approximately 22 indicated horse-power, which is somewhat lower than that for the greatest economy with steam as the working medium.

Tests with Air-steam Mixtures.—After the usual preliminary period of adjustment of apparatus each test with mixtures of air and steam was continued for one hour. A pressure of slightly more than 100 lb. gauge was maintained in the steam main, the amount of steam to the engine being controlled by an auxiliary valve situated near the mixing chamber. The amount of air was regulated by throttling the air compressor. It was found that the proportion of the mixture could be judged and regulated fairly accurately from observations of the temperature just below the mixing chamber. The actual temperature of the mixture at that point proved to be practically identical with the theoretical temperature, where the initial temperatures of the air were 100 deg. and 200 deg., as given in Fig. 5. For higher initial air temperatures, however, the actual temperature of the mixture fell slightly below the theoretical, probably because of increased radiation losses at these higher temperatures.

Indicator diagrams and the following data were secured every five minutes, the brake load and throttle pressure being kept constant :—

(1) Revolutions per minute (by revolution counter).
(2) Temperature at throttle in degrees Fahrenheit.
(3) Temperature in steam chest in degrees Fahrenheit.
(4) Temperature of engine-room in degrees Fahrenheit.
(5) Temperature in exhaust pipe in degrees Fahrenheit.
(6) Temperature in calorimeter in degrees Fahrenheit.

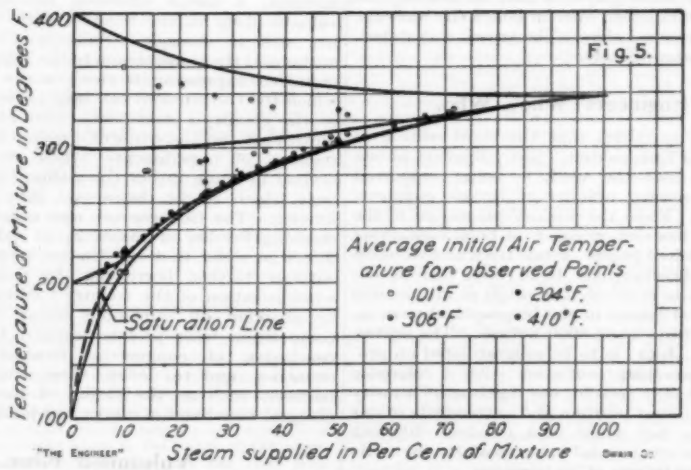


FIG. 5.—*Temperature of Air-Steam Mixtures for Different Initial Air Temperatures and Different Percentages of Air and Steam.*

(7) Pressure of steam entering calorimeter in pounds per square inch (steam main pressure).
(8) Temperature of air entering Venturi meter in degrees Fahrenheit.
(9) Pressure of air entering Venturi meter in pounds per square inch.
(10) Venturi head, by manometer, in inches of mercury.
(11) Temperature of air entering heater in degrees Fahrenheit.
(12) Temperature of air entering mixing chamber in degrees Fahrenheit.
(13) Temperature of condensed steam in degrees Fahrenheit.
(14) Barometer height in inches of mercury (once during test).

The weight of condensed steam was taken at the end of each run. It consisted of the water coming from the condenser, together with that carried by the saturated air exhausting from the condenser and that separated by point of entrance to the heater. It was undoubtedly saturated with water vapour. The temperature of the air being known, the partial pressure of the vapour may be determined from the steam tables. Subtracting this on the engine, as indicated by a loop in the toe of the indicator diagram.

The results of Osborne Reynolds' experiments in 1873 furnish a partial explanation of this phenomenal gain from

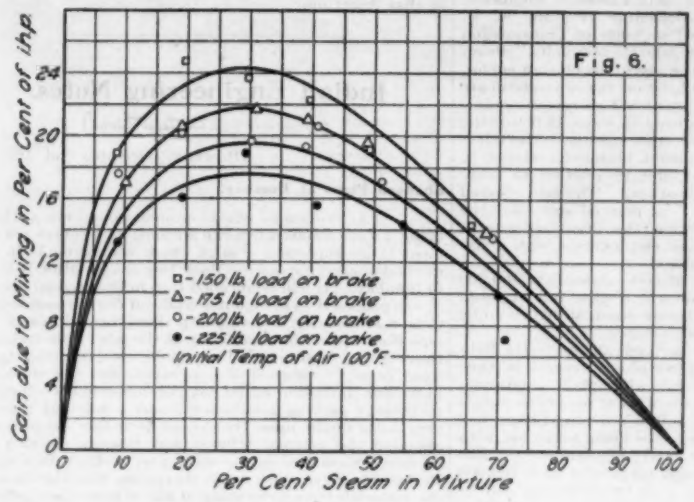


Fig. 6.
Gain due to Mixing in Per Cent of ihp
Per Cent Steam in Mixture
□ - 150 lb. load on brake
△ - 175 lb. load on brake
○ - 200 lb. load on brake
● - 225 lb. load on brake
Initial Temp. of Air 100°F.

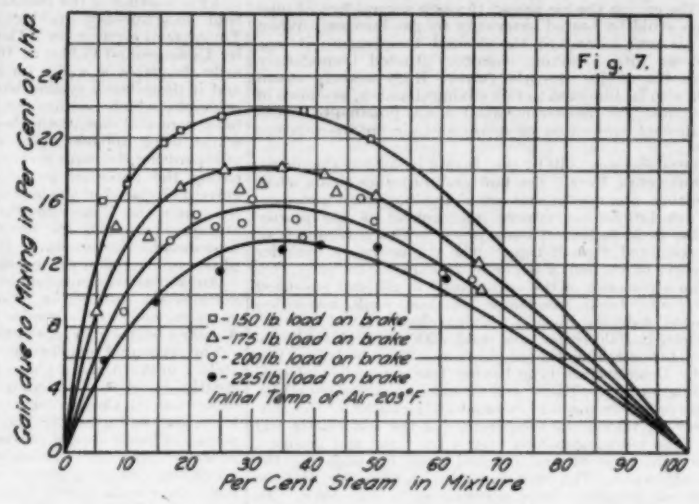


Fig. 7.
Gain due to Mixing in Per Cent of ihp
Per Cent Steam in Mixture
□ - 150 lb. load on brake
△ - 175 lb. load on brake
○ - 200 lb. load on brake
● - 225 lb. load on brake
Initial Temp. of Air 203°F.

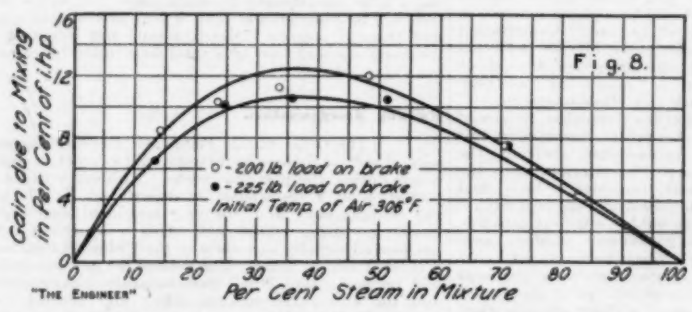


Fig. 8.
Gain due to Mixing in Per Cent of ihp
Per Cent Steam in Mixture
○ - 200 lb. load on brake
● - 225 lb. load on brake
Initial Temp. of Air 306°F.
"THE ENGINEER"

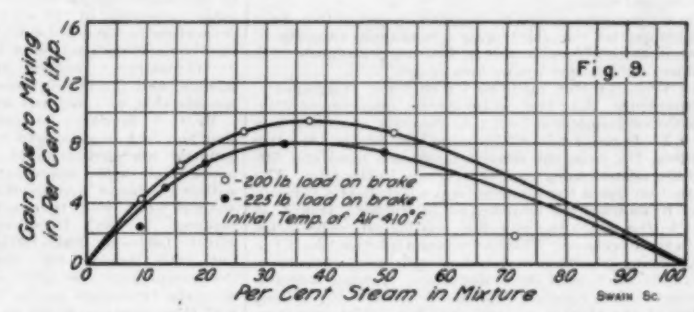


Fig. 9.
Gain due to Mixing in Per Cent of ihp
Per Cent Steam in Mixture
○ - 200 lb. load on brake
● - 225 lb. load on brake
Initial Temp. of Air 410°F.
SWAIN Sc.

FIGS. 6–9.—*Percentage Gain in Indicated Horse-power for Different Percentages of Steam in Mixture. Initial Air Temperatures,* 100°, 203°, 306° *and* 410° *Fah. respectively.*

condensation in the mixing chamber, resulting from heating the air in the tests in which air at a temperature below that of the steam was used. The first and the last of these quantities were obtained by weighing; whereas

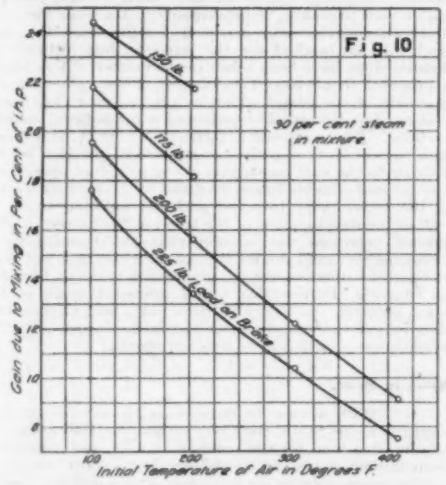
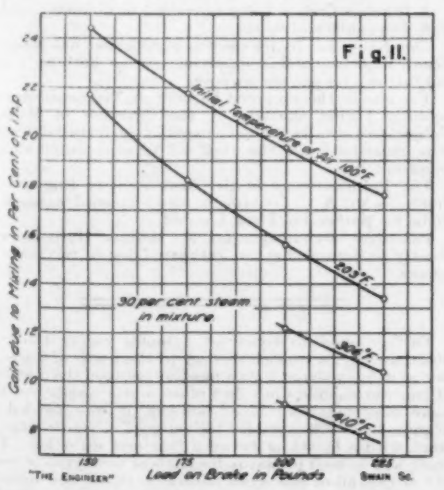


Fig. 10
Gain due to Mixing in Per Cent of ihp
30 per cent steam in mixture
150 lb.
175 lb.
200 lb.
225 lb. load on Brake
Initial Temperature of Air in Degrees F.



FIGS. 10 *and* 11.—*Percentage Gain in Indicated Horse-power with* 30 *per cent. Steam in Mixture for Different Initial Air Temperatures and for Different Loads.*

the amount of water carried off by the air was computed from its temperature and pressure.

The high-pressure air was comparatively cool at the from the total pressure of the mixture secures the partial pressure of the air. The volume of the air may then be computed by applying Boyle's Law, and in accordance with Dalton's Law the vapour must occupy the same volume. The specific volume of the vapour, obtained from the steam tables, divided into the total volume gives the weight of moisture per pound of air. A similar process will determine the amount of moisture in the exhaust air, the temperature of which was that of the condensate and the pressure that of the atmosphere.

The data and results of the air and steam mixture tests are presented graphically by the various curves of Figs. 6, 7, 8, and 9.

Discussion of Results.—The curves illustrating the results of the air and steam mixture tests are in accordance with the stated observations of other experimenters regarding the gain in economy by the use of air and steam together. The curves show that the maximum economy occurs with mixtures containing about 30 per cent. of steam. The maximum gain is more pronounced when cold air, rather than air previously heated, is used. This gain becomes still greater as the load decreases (see Figs. 10 and 11). The gain at the maximum load carried with air at an initial temperature of 410 deg. Fah. is 5 per cent., while the gain at approximately the same load with cold air at a temperature of 100 deg. Fah. is about 15 per cent. At three-quarters of the maximum load and with air supplied at a temperature of 100 deg. Fah. the gain is about 24 per cent. Tests at less than three-quarters of the maximum load carried were impractical because the pressures after expansion were below the back pressures using a mixture of air and steam expansively. In steam engine operation, initial cylinder condensation is chiefly responsible for the great difference between the actual and the theoretical steam consumption Any method which reduces the loss from such condensation will therefore improve the efficiency of operation. Since the total pressure of a mixture of air and steam is the sum of the partial pressures of the two constituents, the steam may be in a superheated condition in such a mixture. When such a condition exists, the initial cylinder condensation is reduced, with a consequent increase in efficiency. A further explanation of the improvement in efficiency may be found in Rankine's statement that the air has a tendency to increase the working temperature limits of the steam, independently of the addition of heat. It may be noted, furthermore, that the presence of air reduces the effectiveness of the interchange of heat between the working fluid and the metal walls of the cylinder, thus causing a reduction in the heat loss.

The increased gain with cold air is due in part to the pre heating effect produced by the steam and to the resulting improvement in mechanical efficiency. The injection of a very small percentage of steam into the compressed air is sufficient to prevent the exhaust temperatures falling below the freezing point.

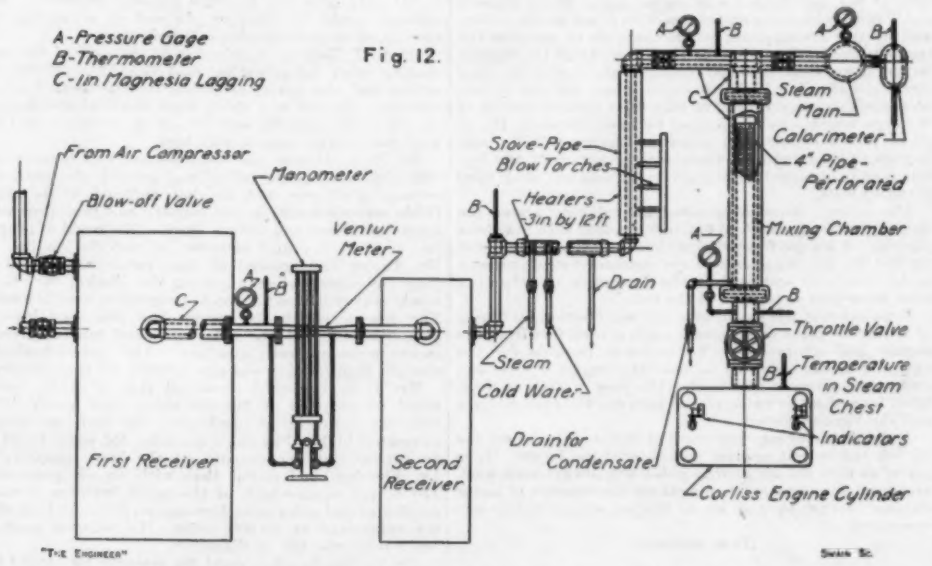


FIG. 12.—*Diagrammatic Arrangement of Experimental Apparatus.*

DESCRIPTION OF EXPERIMENTAL PLANT.

A diagrammatic arrangement of the equipment used is shown in Fig. 12. The air compressor is not shown, but its use is explained and its relative position indicated in the following description of the plant. To reduce the

pulsations of pressure from the compressor, the air was delivered to a first receiver. From the first receiver the air passed through the Venturi tube to a second receiver employed to reduce the pulsations of pressure produced in the air pipe by the engine. Between the second receiver and the engine the air passed through several feet of pipe which could be heated externally by gas burners. When the air was heated to the desired temperature it was delivered into a mixing chamber situated immediately above the engine throttle valve. High-pressure steam could also be admitted to this mixing chamber, as shown in the figure. By this arrangement it was possible to secure the desired proportion of steam and air for the mixture tests.

The engine was built by the Murray Ironworks Company, of Burlington, Iowa. The builders' rating for steam when operating non-condensing with 100 lb. gauge pressure, 100 revolutions per minute, and cut-off at one-quarter stroke, is 24 indicated horse-power. The governor is of the weighted fly-ball type. The engine has a cylinder diameter of 8in. and a stroke of 18.05in.

The accessories of the engine used in all tests consisted of a Prony brake, condenser, weighing tank, revolution counter, reducing motion, mixing chamber, calorimeter, and two Buffalo scales, one used with the brake and the other for weighing the condensate. The condenser was of the Dean surface type having 100 square feet of condensing surface. There was no vacuum pump attached. A thermometer cup was inserted at the outlet of the condenser for taking the temperature of the condensate and air. The reducing motion was of the "rod and groove" type with grooved and notched discs for engaging the indicator cord. The discs were 2¾in. in diameter, and the diagrams produced were approximately 4in. long. An adjustable force-feed lubricator furnished oil to the cylinder and valves.

The air compressor was an Ingersoll-Sergeant two-stage cross-compound machine having a maximum capacity of approximately 375 cubic feet of free air per minute at a pressure of 100 lb. per square inch gauge.

The Venturi meter, made by the Builders' Ironfoundry, of Providence, R.I., had an up-stream diameter of 2½in. and a throat diameter of ¾in.; thus the ratio of contraction was 0.3. It was set in a 2½in. pipe line between the two receivers, 7ft. from the nearest up-stream bend and 5ft. from the nearest up-stream obstruction in the pipe. The obstruction was a thermometer cup which held a thermometer to indicate the temperature of the air; from that point to the meter the pipe line was lagged. The meter was in three sections. The first was the inlet section, 7¾in. long, having a pressure chamber with pipe connection leading to one side of the manometer. A gauge was also attached to this chamber. The middle section, 10¾in. long, contained the throat pressure chamber, which was connected to the other side of the manometer. The third section was an expanding nozzle, 12¾in. long, through which the increase in velocity head acquired at the throat was converted back to pressure head. The manometer had a sliding scale, 22in. long, divided into tenths of an inch. There were pockets at the bottom of the manometer fitted with needle valves to drain off any mercury or water which might accidentally be blown over.

The receiver between the compressor and the meter had a capacity of 65 cubic feet. It was fitted with a blow-off valve which was adjusted by means of a sliding weight. The second receiver, which had a capacity of 17 cubic feet, was located between the meter and the engine. The meter was thereby freed from the disturbing effect of the reciprocations of both engine and compressor, so that there was no appreciable oscillation of the liquid in the manometer.

A portion of the 2in. pipe leading from the second receiver to the engine was fitted with a jacket composed of 12ft. of 3in. pipe sealed with an ammonia fitting at each end. Both cold water and steam were piped to the jacket, and by this arrangement it was possible to regulate the temperature of the air within the lower range, the highest temperature thus attained being slightly greater than 200 deg. Fah. For higher temperatures a battery of four blow-torches was arranged to play on a vertical section of the pipe which was surrounded by approximately 4ft. of stove pipe covered with asbestos lagging. With both heaters utilised simultaneously a temperature of 400 deg. was readily obtained for the maximum amount of air used in the air tests.

The mixing chamber situated immediately above the engine consisted of 4½ft. of 6in. pipe covered with magnesia lagging. A 4in. perforated pipe closed at the end projected up into this mixer and caused any condensed steam present to be separated and held at the bottom of the chamber until drawn off at the end of the test.

Regulation of the steam pressure was effected by means of a throttle valve in the steam main several feet from the engine and compressor. To make it possible for the operator of the valve to be near the engine a rope and pulley arrangement was used. The flow of air was regulated by a throttle valve placed between the first receiver and the Venturi meter.

A thermometer cup was inserted in the elbow where the air left the second receiver and entered the heater. It is probable that the air at that point was always saturated, and from the observed temperature the amount of water vapour carried by the air to the mixing chamber was computed.

(To be continued.)

At a meeting of the Optical Society held at the Imperial College, on Thursday, December 14th, there was, among the papers read, one on "A Constant Bubble," by S. Weston, in which the author pointed out the difficulty, always encountered in an accurate spirit level of the type usually mounted on surveying instruments, caused by the alteration in the length of the air bubble brought about by variation of temperature. This difficulty has been entirely overcome, he said, in the new type of level produced by E. R. Watts and Son, Limited, and known as a "constant" bubble. The first consideration in the manufacture of such a bubble is to obtain the exact proportion of air and spirit. The cross-section of the tube containing the liquid is of such shape that as the temperature is raised and the surface tension gradually decreases, only the cross sectional area of the bubble is affected, its length remaining unaltered.

High Pressure Cables.

At a meeting of the Institution of Electrical Engineers, held on Thursday evening, December 7th, Mr. A. M. Taylor read a paper on "The Possibility of Transmission by Underground Cables at 100,000/150,000 volts." Primarily the paper is a plea for the use of single-core cables, and it describes a system working on the separate-phase principle, which permits the pressure between the outermost core and earth being reduced to some 18,000 volts, whilst using 100,000 volts for transmission. The effect of separating the cores is considered, both in its relation to easing the potential gradient and in relation to eddy currents induced in the lead sheathing. The gain effected by employing "intersheaths" is pointed out, and the author's proposals for obviating the disadvantages of intersheaths by combining their employment with a six-phase transmission are considered.

An actual transmission of 50,000 kilowatts at 100,000 volts over a distance of 30 miles is worked out in detail and compared with a similar transmission at 30,000 volts. A saving of, roughly, £500,000 is shown.

The principal conclusions arrived at are:—(1) Reliability under the six-phase/three-phase system is very greatly increased, as compared with plain single-core cables—as at Gennevilliers—or with three-phase cables for equal voltage. (2) The author's arrangements will permit of loads of poor power factor being taken up, with positive gain in efficiency and regulation. (3) The maximum voltage gradient being no greater with 100,000 volts than with 30,000 volts, such transmissions can be undertaken immediately the cable makers are in a position to guarantee the cables. (4) The investment in capital outlay proceeds, in the six-phase/three-phase scheme, in proportion to the development of the load. A start could thus be made with only 8000 kilowatts. (5) The reduction in line-charging current in the six-phase/three-phase scheme, and the improvement in "regulation" are very considerable, as compared with any other proposals.

Mr. C. P. Sparks, who opened the discussion, remarked that the lack of adequate water-power resources in this country rendered straight transmission, such as the paper dealt with, unnecessary. The alternative to the author's scheme was overhead transmission lines, and analysis would show that such lines would be most advantageous. In 1887, 10,000-volt cables were put into use, whilst between 1902–1903, 20,000-volt cables were put into service on the North-East Coast. At the present time the cable manufacturers were prepared to make three-core cables for 40,000 volts and over, and that pressure could be used without complication. Mr. Sparks also remarked that it was not desirable to have cables working at the pressures suggested, unless they were armoured. The speaker's main contentions were that if straight transmission was necessary, overhead transmission lines should be used, and that the maximum pressure for three-phase cables was not 40,000 volts.

Dr. Fleming said that if railways were going to be electrified cables would have to be used. The dielectric strength of air increased with the pressure, and the possibility of using compressed air for insulating conductors might be worth considering. One conductor could be placed concentrically inside a tubular conductor with a distance of, say, 1in. between them, and the compressed air could be made to fill the intervening space. Slight leaks might be an advantage, as they would have the effect of allowing moisture to escape. Experiments on those lines might be of practical value, as the compressed air would only give rise to small capacity currents. Electricians would, he thought, do well to remember that they lived in an insulating atmosphere.

Mr. C. J. Beaver, in referring to the part of the paper dealing with intersheaths, said that Dr. Morris and others had also given attention to that branch of the subject. He did not think that the author's demands on the cable maker's were at all ex- orbitant, and they were ready to co-operate with him.

Mr. P. V. Hunter said that he had experienced some difficulty in deciding what had caused the author to propose a scheme such as that outlined in the paper. Cable manufacturers in this country had been proceeding upon quite fixed and definite lines. The trend of progress had been to try and increase the specific loading, but Mr. Taylor had ignored all that progress and had not done the cable makers anything like justice. Mr. Taylor would apparently put a stop to progress in specific loading. The scheme which the author had described involved complications, and the switchgear and bus-bar arrangements necessary were appalling. Any system limited to straight transmission was not suitable for this country.

Mr. J. S. Highfield remarked that if direct current could be supplied at 100,000 volts there would be no difficulty with ¼in. of insulation. He had been greatly interested in Dr. Fleming's remarks, for some years ago he carried out experiments on the lines suggested by Dr. Fleming, and found that with an air pressure of 120 lb. per square inch in the space between a copper conductor and outer tube there was no difficulty in working the conductor at 60,000 volts. He believed that the outer tube was 4in. in diameter.

Mr. P. Dunsheath opened his remarks by saying that when he received the paper he started to deal with the errors and the points with which he did not agree, but he soon found that that line of procedure would take up too much time. It was possible, Mr. Dunsheath explained, to transmit all the power referred to in the paper over three three-core armoured cables 4.5in. in diameter.

Professor Cramp referred to the possibility of a charge between the intersheaths and dielectric setting up a discharge and producing ozone. He also pointed out that the units used in the paper were the same as those employed in the United States, and those units, he thought, would have to be generally adopted.

In his reply to the discussion, the author said that Mr. Sparks and Mr. Dunsheath had referred to the possibility of transmitting the load referred to in the paper by means of three-core cable, but they had avoided taking into account the value of the copper that would have to be put into those cables. The question that had to be considered was what number of cables were comparable from the point of view of the losses. Referring to Mr. Hunter's remarks about complications, the speaker said that engineers did not worry about the complications which were introduced by rotary converters, and he did not see that there was much room for complaint in that direction.

Indian Engineering Notes.

(From our own Correspondent.)

Bombay, December 2nd, 1922.

Changed Plans at Bombay.

Although no official announcement has yet been made, I have received from an authoritative source a statement of an important change which will be made in the method of carrying out the Back Bay Reclamation Scheme in Bombay. It will be recalled that in the original project it was proposed to dredge materials on the harbour side of Colaba Peninsular, and to pump them through a series of pipe lines across the Peninsular to the site of the reclamation on the other side. This would involve pumping, in some cases, a distance of four miles, and the efficiency losses due to friction would have been enormous. Subject to borings proving satisfactory, and I am told there is very little doubt upon that point, it is now proposed to abandon the original scheme and, instead, of carry on dredging operations in the other part of Back Bay itself. Reduced to its simplest terms this means that the distance the materials have to be pumped will be more than halved; indeed, in some places the distance will be no more than half a mile—and thereby it is anticipated that the reclamation will be completed at least a year sooner than was at first thought possible. Nearly a mile and a-half of the retaining sea wall, out of a total four miles, has already been completed.

Railway Reorganisation.

The Great Indian Peninsular Railway has made several radical changes in its traffic and locomotive departments during the past few weeks. An innovation is the formation of a transportation department, to which all the running staff from the two first-mentioned departments are being transferred. This is a scheme which has proved signally successful in the United States, but it is entirely new to India. The head of the new department will be designated chief transportation superintendent, and the locomotive superintendent and general traffic manager will in future be known as chief mechanical engineer and chief traffic manager respectively.

Ports of Ceylon.

The congestion and lack of modern facilities at Colombo have long been the subject of comment in shipping circles, and many suggestions have been brought forward with a view to making improvements. A scheme for a wet dock was provisionally sanctioned some time ago, and land was ear-marked for the purpose, but hitherto no definite steps have been taken in the matter. Now comes a proposal to develop Trincomalee, a tiny place on the east side of the island which as yet has no railway connection, but nevertheless possesses a magnificent natural harbour. This proposal is fathered by Mr. A. D. Prouse, who, in connection with the proposed extension of the railway to the east coast, was asked to report upon "the present and possible future facilities of the ports of Ceylon in the interests of Imperial and international trade, as well as the development of the trade of the Colony." Mr. Prouse expresses the opinion that the opening up of Trincomalee would render the construction of a wet dock at Colombo unnecessary for some years to come, because, he suggests, Trincomalee would intercept much of the trade between the Bengal-Burma ports and Ceylon, and thus relieve the congestion at Colombo. Apparently the whole question will now be debated afresh.

News in Brief.

With a view to developing the cotton-spinning industry in his State, the Chief of Kotah—Rajputana—is offering free land for the erection of mills and exemption from import duties on machinery and export duties on manufactured articles for five years after a mill is opened.

A Wireless Club is being organised in Colombo by Mr. J. S. Dinwiddie and others.

The Naini Tal hydro-electric installation has recently been completed, and is supplying current both for street lighting and for private purposes.

The site of the proposed harbour at Vizagapatam was recently visited officially by the Governor of Madras. Subject to a satisfactory settlement of the financial details, it is understood that the work will be commenced almost immediately.

The President-elect of the Institution of Engineers—India—is Mr. A. C. Coubrough, who is general manager in India for Mather and Platt, Limited.

Passenger accommodation at Madras Harbour will shortly be improved at an estimated cost of two lakhs of rupees.

The proposal to construct a motor racing track at Montmorency, a wooded district to the north of Paris, is taking definite shape. At a meeting between the directors of the Automobile Club de France and a number of the more important motor car builders, it was decided to acquire some 900 acres for the purpose of constructing a track with a length of between four and six miles. The track will be used primarily for trials of new types of cars; not of cars all of one series naturally, but of new models, and it will be let out to one firm at a time. According to the *Auto*, a company is at present being formed by the firms of Ballot, Dalage, Hispano-Suiza, and Panhard and Levassor. Although the track is intended primarily for trials of new cars, the opinion is held locally that in time it will become a French Brooklands, and that the Grande Prix will be run on it.

Railway Matters.

CERTAIN appointments to positions under the London and North-Eastern Railway were announced on the 14th instant, but they did not relate to the civil engineering and mechanical engineering departments. It is instructive to note that the headquarters of the company are to be at Marylebone Station.

THE total goods receipts for September, 1922, were 11 per cent. lower than in the corresponding period of 1921; but, owing to an increase of 29 per cent. in coal, coke and patent fuel and of 25.2 per cent. in other minerals, the goods train miles were 10 per cent. more, the average train load increasing from 124 to 127½ tons and the net ton-miles per engine hour increasing from 431 to 449.

REPRESENTATIVES of the local authorities in the Oldham and Rochdale district are urging the London and North-Western Company to proceed with the proposed electrification of the lines in that vicinity. They are reminding the railway company that at a Lancashire and Yorkshire shareholders' meeting the chairman said, "We are satisfied that it will be a paying proposition for the company."

WHEN the North-Western, Midland and West Scottish grouping scheme came before the Railway Amalgamation Tribunal on Tuesday last objection was taken to the name of the new company being the London, Midland and Scottish. It was said that this name suggested that it served the whole of Scotland and that West Scottish would be better. The Tribunal reserved judgment on this point.

AT the annual meeting of the National Union of Railwaymen last July it was decided, on the advice of the executive, to ask the branches as to the union affiliating with the National Transport Workers' Association. The branches voted against it, and then the executive, on the ground that the question had not been sufficiently considered, referred the matter back. The vote has again gone against affiliation.

IT is officially announced that the headquarters of the London, Midland and Scottish Railway will be at Euston, that the chairman will be the Hon. C. N. Lawrence, the chairman of the London and North-Western, the deputy chairmen Sir Guy Granet and Mr. E. B. Fielden, the secretary Mr. R. C. Irwin, and the general manager Mr. Arthur Watson. Confirmation is given of the statement made in this column on the 15th instant as to a local committee of directors for the Scottish division.

THE weight of goods traffic conveyed in September, 1922, viz., 28,476,396 tons, was greater than in any month since September, 1920, and represented an increase of 5,176,498 tons, or 22.2 per cent., over September, 1921. The tonnage of general merchandise remained stationary, but coal, coke and patent fuel increased by 29 per cent. and other minerals by 25.2 per cent. The tonnage of coal, coke and patent fuel exceeded the figures recorded for any month since monthly particulars became available for January, 1920.

IN President Harding's Message to Congress on its reopening on the 8th instant the abolition of the Railroad Labour Board in favour of a Labour Division in the Inter-State Commerce Commission, with power to enforce its rulings, was proposed. Mr. Harding urged the co-ordination of all transportation facilities, including inland waterways and motor truck transportation, and suggested a merger of lines into systems with an interchange of goods cars, the consolidation of facilities and the co-operative use of termini in order to effect necessary efficiency and economy.

AT a meeting of the proprietors and debenture stockholders of the Great Western Railway, held on the 15th instant, approval was given to the terms for the absorption of nine subsidiary companies. The net income of these companies was £16,000 a year, which was 4 per cent. on the £400,000 being paid for their purchase. Since the meeting was summoned terms have been agreed with the Didcot, Newbury and Southampton also, and the only companies remaining for the Amalgamation Tribunal to deal with are the Exeter, the Forest of Dean, and the Midland and South-Western Junction.

IN announcing that Mr. Charles Sheath, the secretary of the South-Eastern Railway and of the South-Eastern and Chatham Joint Managing Committee, had been made a director of the new Southern Railways Company, the chairman said that Mr. Sheath's record in the history of the railway industry was probably unique. Half a century ago, as a lad of fourteen, he entered the secretary's office of the South-Eastern Railway Company, and, following the advice given him by the late Mr. Samuel Smiles, the author of "Self Help," then secretary of the company, that "a rolling stone gathers no moss," he had never from that day rolled out of the secretary's office.

THE total number of passenger journeys, exclusive of those of season ticket holders, in September, 1922, was 102,157,077, a decrease, when compared with the corresponding period of 1921, of 2,489,149, or 2.4 per cent. The reductions in journeys at full fares amounted to 12.1 per cent., and in workmen's fares to 4.9 per cent. Cheap fares increased 79.2 per cent., but many of them had not come into operation in the corresponding period. Despite the decrease in the number of passengers, there was an increase of 8.6 per cent. in the passenger train mileage, owing, we suggest, to competition with a view to better figures to put on the table when grouping terms were being discussed.

SPEAKING at the fortieth convention of the Roadmasters and Maintenance of Way Association, the chief engineer of the Cleveland, Cincinnati, Chicago and St. Louis Railroad, said:—"I have been more concerned over this situation with reference to the maintenance-of-way foreman than any other problem before me. We must find a way to regain his confidence, and his old-time interest and pride in his work. I cannot believe that they have disappeared, but they are submerged for the time being. You men are the connecting link between the railways and their maintenance-of-way employees. Upon you rests the responsibility for the restoration of the former relations. Don't lose sight of the value of personal contact with your men. Don't widen the existing gap; close it."

Notes and Memoranda.

THE richness of the original gold-mining claims on Cedar Creek, British Columbia, is being shown, according to the *Raw Materials Review*, by the fact that two rockers, washing 2½ yards of gravel, took out 103 oz. of gold on one day and 83 oz. the next. This represents a value of 17 dols. to the ounce. One nugget worth 62 dols. was found.

WHAT is said to be the largest structure of its kind in Asia is the Marunouchi building now nearing completion in Tokio and owned by the Mitsubiahi Goshi Kaisha. It is to be used exclusively for offices and covers a plot measuring 300ft. by 350ft. It is eight storeys high, and is of structural steel with reinforced concrete arches and cement floors. The exterior of the structure consists of a granite base succeeded by a storey of architectural terra cotta, and above that by six storeys of brickwork faced with the Japanese type of finishing.

DURING the fiscal year ended June 30th, 1922, there was produced from American Government lands other than Indian lands 18,236,362 barrels of petroleum, of which the Federal Government received as royalty 3,616,852 barrels, worth 4,768,397.61 dols., not including bonuses. In addition, at the end of the year, 14,000 dols. a month was being received by the Government from natural gas leases on public lands in Wyoming. In the Rocky Mountain field alone there were on Government land 336 oil wells, of which 267 were in the Salt Creek, Wyoming, field. A hundred other wells were being drilled.

THE forest wealth in Czechoslovakia is enormous, and the Republic ranks among the most richly wooded countries of Europe. The forest land amounts to 32 per cent. of the whole area. Altogether about 4,014,803 hectares are covered with forests and woods. Czechoslovakia thus has a forest area nearly four times larger than that of England, over one-half that of France, and more than the whole afforested part of Italy. Under normal conditions this natural wealth could be made to yield 10,817,051 cubic metres of soft timber annually. About 30 per cent. of this consists of firewood, thus leaving about 8,000,000 cubic metres for industries and building purposes. In addition to this, about 2,000,000 cubic metres of hard timber could be obtained.

IN the course of an address on "Tin-plate Machinery" before the South Wales Institute of Engineers, Mr. H. Spence Thomas stated that, speaking roughly, the cost of running a plant electrically was about double that of the coal consumption alone. Whether the cost of labour and the inconveniences of making their own steam, and the upkeep of the plant, and so on, were equivalent to the double cost of electricity was a matter for calculation. If they proposed to drive electrically and make the current they would be told by people who sold generators that they could do so at an extremely low figure; and if they were going to buy their current they would find they would have to pay about a penny a unit for it on tin-plate works load.

IN commenting on the explosion of a vertical boiler on board a small Dundee salvage boat, the Engineer Surveyor in Chief, Board of Trade, remarks that the failure was apparently due to a heavy deposit of lime scale, which was no less than ¾in. thick on the interior surface of the tube that failed. The working equipment was somewhat deficient as the feed pump was also used as a bilge pump, in consequence of which oil from the bilges was pumped into the boiler and oil in boilers frequently leads to overheating. Although sea water was sometimes used as feed, no instrument for ascertaining the density of the boiler water was provided, and internal inspection and cleaning of the boiler was carried out only once every six months. Altogether, the method of working was such as might be expected sooner or later to lead to a serious mishap.

ASSAY tests on a sample of Brazilian "turfa" have recently been completed at the Boulder, Colo., field office of the United States Bureau of Mines. This material is a soft brownish-yellow substance, having an apparent specific gravity less than that of water. It yields on distillation as much as 113 gals. of crude oil of 0.870 specific gravity, and, in addition, up to 6 gals. of scrubber naphtha per ton. The oil is stated to be of very good quality as shale oils go, and the material also gives a relatively high yield of gas. In retorting, the turfa shrinks to about one-third of its original volume, and forms a weakly adherent coke probably of fair fuel value. The effect of rate of oil production on the quality of oil was, it is reported, shown up very strikingly in the examination of this material. For example, petrol produced from oil made from this material at the rate of 1 c.c. per minute was 34.0 per cent. unsaturated, while the paraffin fraction was 41.5 per cent. unsaturated. From crude oil produced at the rate of 0.2 c.c. per minute, the petrol produced was 30.1 per cent. and the paraffin 33.6 per cent. unsaturated.

IN the course of a lecture on brown coals and lignites, at the Royal Society of Arts recently, Professor W. A. Bone gave some information with regard to the progress of the Victorian Government electric power scheme for utilising the brown coal deposits at Morwell in the generation of electricity. The scheme provides for the erection of a generating station on the coalfield with an initial capacity of 50,000 kilowatts, but capable of expansion to at least 100,000 kilowatts, at an estimated cost of £2,500,000. When the scheme has been fully developed, in about 1924, it will involve an expenditure of over £6,000,000. The plant for the first section of the station will include four 12,500-kilowatt turbo-alternators running at 3000 revolutions per minute, and a set of 800-kilowatt capacity for starting up the larger generators. This plant is being manufactured by the Metropolitan-Vickers Electrical Company. An order for twelve boilers has been secured by John Thompson, and the steel buildings comprising the station are being manufactured by the Redpath Brown Company. Preliminary steps are being taken for the erection of the high-tension transmission line from Morwell to Newport, near Melbourne, a distance of 112 miles. This line is to operate at 132,000 volts and will consist of aluminium steel reinforced cable strung on galvanised towers spaced about 1000ft. apart.

Miscellanea.

THE Calcutta Corporation has decided to begin dredging the Bidyadhari River, into which the city's sewage and storm water drain, and which is rapidly silting up.

TWO more large generating sets, together with the necessary boilers and auxiliary machinery, are to be installed in the plant of the Victoria Falls Power Company at Johannesburg.

IT is expected, says the *South African Mining and Engineering Journal*, that the Congo will in the near future raise a loan in the United States of some 20,000,000 dols. in order to ensure the rapid completion of the programme of equipping the State with various kinds of machinery and implements.

IT was recently announced by the Premier of Tasmania that the Great Lake hydro-electric scheme will be completed by the end of the current year, when the maximum demand of 63,000 horse-power can be catered for. Of this, 54,000 horse-power has already been sold. The undertaking showed a profit of £15,000 last year.

IT is said that the Kimberley Mines will restart production in January next. The company has ample blue ground on the floors to occupy the machinery a long time without any need to restart work underground. The New Eland Diamond Company is also resuming operations, and it is hoped to have the mine working to its full capacity in about six months' time.

ARRANGEMENTS have now been made by the Birmingham Chamber of Commerce, in conjunction with the British Cast Iron Research Association, to hold the next International Foundry Trades' Exhibition at Birmingham in the early summer of 1924. Steps will be taken to ensure a greater international representation at the 1924 Exhibition, and arrangements will be made to increase the schedule of the foundry employees competitions.

NEW discoveries of gold and silver are reported from British Columbia. Development work at the head of Canyon Creek in the Lardo country has uncovered very rich ore assaying 2000 oz. of silver to the ton, in addition to fair gold values. A new gold strike, reported on Hills Bar Creek, in the Hope district, comprises three quartz vein outcroppings, varying in width from 4ft. to 15ft., and traceable for nearly a mile in length, showing free gold.

IT is announced that Sir Oliver Lodge will give a Silvanus Thompson Memorial Lecture at the Technical College, Leonard-street, E.C. 2, on Friday, January 26th next, at 7.30 p.m. The subject will be "The Basis of Wireless Communication." After the lecture there will be a reception of old students. Some of the latter have promised interesting scientific demonstrations in the laboratories, and many of the Doctor's pictures and instruments will be on view.

THE Argentine Ministry of Public Works has made a proposal to the Legislature of the Province of Mendoza for the installation of a hydro-electric plant and irrigation dam at the Nihuil Falls, on the river Atuel. There is a fall of 100 m. in a distance of 500 m., while the gorge is not more than 7 m. wide at its narrowest point. The mean flow of the river is 40 cubic metres per second, with up to 500 cubic metres during the rainy season. The proposed development of electrical energy amounts to 40,000 horse-power.

THE Crystal Palace School of Engineering is celebrating its jubilee this year, having been established in 1872. Sir William Moir, Bart., presided at the 150th certificate day this week. The recipients of awards included Mr. F. P. Fasham, who secured the School's medal, and Mr. W. E. L. Adams, who took the Wilson Premium for his paper on "Harbour and Port Construction." In his address Sir William said that he thought it an extraordinary record for such a school to have been under one family—the Wilsons—for fifty years.

IT is reported by the National Federation of Iron and Steel Manufacturers that the production of pig iron in November amounted to 493,900 tons and of steel ingots and castings to 600,800 tons. In the case both of pig iron and of steel, this is the highest total attained since the coal stoppage of 1921. In the case of pig iron, however, production is still only 57 per cent. of the average monthly production of 1913. Included in the production of pig iron are 148,600 tons of hematite, 145,000 tons of basic, 134,900 tons of foundry and 33,100 tons of forge pig iron.

THE first broadcasting concession granted by the Municipal Government of Buenos Aires is about to be carried out in Argentina. It has been given to a native engineer, and is confined to the provision of subjects of an educational and recreational nature. In this connection, an installation of wireless telephonic transmitting apparatus will shortly be required. The concession is in no way a monopoly, the Government reserving to itself the right to grant similar favours to other companies, although not upon quite the same favourable terms as those conceded to the first applicant.

MEMBERS of the Committee of the Société Française Aérienne have visited Cherbourg and the Contentin region for the purpose of arranging a competition for motorless flight, to be held next year on the coast of Normandy. The delegates have chosen for the site of the meeting the sand dunes of Biville and Vauville, which surround bays protected from the east wind. M. Maneyrol will be asked to visit the dunes in order to give his opinion as to the suitability of the spot chosen, and if his approval is obtained, details with regard to the organisation of the meeting will then be considered.

THE International Commission which has been sitting in Shanghai since March 31st last, with the object of working out a revised Chinese import tariff in accordance with the decisions reached at the Washington Conference, has now completed its labours. The task before the Commission has been to place the Chinese tariff upon an effective 5 per cent. *ad valorem* basis and the new schedule of duties came into force on December 1st. All goods shipped on and after that date will be subject to the revised tariff, bills of lading being taken as evidence of shipment. Details of the new duties are not yet available in England.

MACHINERY ON THE COAL WHARF AT DULUTH

(*For description see page 653*)

FIG. 11—SCREENING HOUSE FOR BITUMINOUS COAL

FIG. 12—REAR OF BITUMINOUS COAL SCREENING HOUSE

FIG. 13—LOADER FOR DELIVERING COAL INTO COVERED RAILWAY WAGONS

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Contents.

THE ENGINEER, December 22nd, 1922. PAGE

CONTINUOUS BRAKES FOR GOODS TRAINS 653
COAL WHARF AND MACHINERY OF THE NORTH-WESTERN FUEL COMPANY OF AMERICA. No. III. (Illus.) 653
A NEW LIFEBOAT ENGINE. (Illus.) 656
RECLAMATION PLANT AND ITS OPERATION. (Illus.) 659
A SEVEN-DAY JOURNAL 661
A STUDY OF AIR-STEAM MIXTURES. (Illus.) 662
HIGH-PRESSURE CABLES 664
INDIAN ENGINEERING NOTES 664
RAILWAY MATTERS 665
NOTES AND MEMORANDA 665
MISCELLANEA 665
LEADING ARTICLES—
The Training of Naval Engineers 667
The Validity of Einstein's Doctrine 668
INSTITUTION OF MECHANICAL ENGINEERS 668
STEAM BOILER MATTERS 669
HOT-WATER BOILER WASH-OUT SYSTEMS 669
MANCHESTER WIRELESS BROADCASTING STATION. (Illus.) 670
BRITISH SLEEPING CARS FOR THE CONTINENT. (Illus.) 671
PRINCIPLES OF BOILER DESIGN. (Illus.) 672
LETTERS TO THE EDITOR—
The Human Side 673
Errors in Gauging 673
Electric Locomotives 673
A Corrosion Puzzle 673
A "BACK-PRESSURE" PROCESS STEAM PROBLEM. (Illus.) 674
1500-VOLT ROTARY CONVERTER 674
THE CAPROTTI LOCOMOTIVE VALVE GEAR. (Illus.) 674
PROVINCIAL LETTERS—
The Midlands and Staffordshire 675
Lancashire 675
Sheffield 676
North of England 676
Scotland 677
Wales and Adjoining Counties 677
LAUNCHES AND TRIAL TRIPS 677
PERSONAL AND BUSINESS ANNOUNCEMENTS 677
CURRENT PRICES FOR METALS AND FUELS 678
FRENCH ENGINEERING NOTES 679
BRITISH PATENT SPECIFICATIONS. (Illus.) 679
FORTHCOMING ENGAGEMENTS 680
PARAGRAPHS—Roller Bearing Plummer Blocks—Commercial Fair in Madagascar—Institution of Mechanical Engineers 660
Russian Engineers—The Fourth Brussels Commercial Fair .. 677
Contracts 680

TWO-PAGE SUPPLEMENT—90 H.P. PETROL ENGINE FOR BRITISH LIFEBOATS.

THE ENGINEER.

DECEMBER 22, 1922.

The Training of Naval Engineers.

AN announcement of capital importance to the Navy in general and the engineering branch in particular was made by the Admiralty on the 15th inst. It signifies the virtual abandonment of the scheme which aimed at suppressing the distinction between the executive and engineering branches of the Navy. Introduced in 1902, this scheme has been in force twenty years, though it did not become absolute until 1905, entries of engineer students having been continued, on a much reduced scale, for three years after the system of common entry had been adopted in principle. The premises upon which the Admiralty of 1902 based its decision to revolutionise the method of entering and training officers for the engineering branch were set forth at length in the Selborne Memorandum of that year, and amplified in the Cawdor Memorandum issued three years later. In both documents the commanding influence that machinery had come to exert in the naval sphere was emphasised. "In the old days it sufficed if a naval officer were a seaman. Now he must be a seaman, a gunner, a soldier, an engineer, and a man of science as well." Therefore, it was argued, the logical course was to train the future officer to be equally at home on the bridge or in the engine-room. Fervid partisans of the scheme predicted a time when the deck officer and the engineer would no longer be specialists in the sense that one could perform deck or engineering duties better than the other. They were, in fact, to be absolutely interchangeable. This idea, like so many other daring innovations, sprang from the fertile brain of Lord Fisher, but it is now almost universally admitted to have been one of his least happy inspirations. Certainly it never evoked enthusiasm in the engineering world—as our own comments at the time clearly showed—nor was it ever warmly approved by the Navy as a whole. The first departure from the basic principle of interchangeability was foreshadowed in 1918, when, under the Admiralty regulations promulgated that year, a large majority of engineering specialists renounced the option of reverting to deck duty between seven and a-half and nine years' seniority. The process of separation was carried a long stride forward in 1920, when the First Lord announced in his statement on the Navy Estimates that officers selected for the engineering branch when sub-lieutenants would, after taking the advanced engineering courses, be definitely ranked as engineer officers, and never thereafter revert to deck duties. It was essential, the First Lord added, that the majority of officers forming the engineering branch should be "whole-time" officers, in view of the fact that a definite distinction existed, both as regards knowledge and capabilities, "between those who are to be trained in the science of naval war and strategical and tactical methods of fighting, and those who are to deal with the upkeep and maintenance of engineering and mechanical appliances which are necessitated by the complex machinery and weapons of modern war. Each side requires a special study, and for this reason final separation of the branches is essential." These are truths that one would have supposed to be as patent in 1902 as they are to-day, for even twenty years ago the whole tendency of the professional and industrial system was towards greater specialisation. In July, 1920, an Admiralty statement explained the new policy in detail. In accordance therewith, the transfer of duties in connection with the electrical installations of warships was arranged, these duties, hitherto vested in the torpedo lieutenant, a deck officer, being taken over by the engineering department. This change is to be made gradually, and will not be completed until a sufficient number of engineer officers who have qualified in the advanced electrical course are available to relieve the torpedo specialists throughout the Fleet of responsibility for the electrical installations on board.

But while the two branches are henceforth to be entirely separate so far as their professional duties are concerned, the present system of common entry for both executive and engineer officers, and for common training until a certain stage is reached, will be continued. This means that the one thoroughly commendable feature of the original Selborne scheme is to be retained. Common entry undoubtedly fosters that close mutual understanding and co-operation between executives and engineers which, in the Admiralty's words, are "essential to the efficient use of a Fleet in modern warfare." The future deck and engineer officers of the Navy will therefore enter Dartmouth together, and together undergo that early training which stamps the impressionable mind of youth so indelibly. Both will be bred up, as it were, in the traditions of the great Service to which they belong. Final separation will come immediately on passing out of the cadets' training ship, when those destined for the engineering branch will undergo a course of four years in mechanics and electricity at Keyham College and in H.M.S. Vernon before being assigned to duty afloat. Some years must, of course, elapse before officers trained under the new system become available for duty as engineer officers, and, consequently, the present method of specialisation is to remain in operation for the time being. The final selection of officers to specialise under the existing scheme is to be made early in 1924, and the final course will commence in October, 1924. Incidentally, it is very desirable that the parents or guardians of boys whom it is hoped to enter as naval cadets should familiarise themselves with the details of the new scheme as described in the Admiralty memorandum, for while it is expressly stated that all cadets of the military branch will enter under the same conditions and receive identical training until they are rated midshipmen, it is also laid down that officers selected to specialise in engineering will separate finally and irrevocably from the executive branch, "and though remaining in the military branch will forego all right to subsequent reversion to deck duties and to military command." The decision as to whether a cadet is to specialise in executive or engineering duty must be taken before the last term in the sea-going training ship begins, as applications to specialise in the latter branch are to be made at the commencement of this term. Each application will be accompanied by an opinion from the commanding officer of the training ship as to whether the applicant shows promise of becoming an efficient engineer officer. Besides the technical training received at Keyham and in the Vernon, engineer officers are to be instructed in the duties of Divisional Officer and the practice of exercising command. They will also receive instruction in general educational subjects, including modern languages, naval history and elementary economics. The career of the engineer officer is in future to be made more attractive by opening up new channels of preferment, resulting, in part, from the improved status and enlarged province of the department of the Engineer-in-Chief. While continuing, as at present, to be responsible for the design and supply of engineering material, this officer now becomes principal adviser to the Board of Admiralty on all matters concerning naval engineering policy, a function that will bring him into close touch with the Naval Staff.

He will act in the same capacity to the Board in all questions relative to the training of engineering *personnel*. The Engineer-in-Chief's department will therefore undergo considerable expansion, with a corresponding increase in the number of administrative appointments open to senior engineer officers. These will also be eligible to serve as Admiral Superintendents of the Royal Dockyards, posts which heretofore have been filled exclusively by deck officers.

We are unfeignedly glad that the Admiralty has decided to extend the principle of promotion from the lower deck to the engineering branch of the Service. This scheme, which was first approved in March, 1921, is now to be put into effect. A limited number of lads, selected from those who have shown exceptional ability during their course of training in the Artificer Apprentices' Training Establishment, are to be rated midshipmen and appointed to the R.N.E. College at Keyham, there to go through the course of instruction side by side with the other midshipmen, with a view to their becoming officers of the engineering branch. In the opinion of those competent to judge, the Navy stands to benefit by this step, for youths who gain commissioned rank in this way will necessarily possess a marked aptitude for engineering, and their talents will be given a wider scope than would have been possible had they remained on the lower deck. Now that the complete scheme of future training for naval engineer officers has been disclosed, we are confirmed in the opinion we expressed when it was first outlined nearly three years ago, viz., that it is based upon sound principles, and represents a decided change for the better in the prospects of naval engineer officers.

The Validity of Einstein's Doctrine.

From the time of Copernicus and Galileo to the introduction of the origin of species and the modern theory of vitamines it has been the fate of all great developments of scientific thought to be both bitterly opposed and ardently supported. That the Einstein theory of relativity should have been accepted by some and rejected by others is therefore completely in keeping with precedent. The warmth of the welcome accorded to it by a large body of astronomers, physicists, mathematicians and others leaves little room for doubt that it is found satisfying to many scientifically trained minds. Where it is accepted, it is received with a completeness and unanimity which, to the outside observer, is a little surprising in view of the slender nature of the experimental or observational evidence upon which its verification has so far rested. So powerful, indeed, is the support given it that criticism of the theory has been partially stifled. A few eminent scientists, such as Sir Oliver Lodge, have from the first refused to accept it, and have boldly raised their opinions against those of their fellows; while in some quarters, notably in Germany, the principal author of the theory has, on grounds more personal, perhaps, than scientific, been treated with hostility and even threatened with physical violence quite in the mediæval manner. It cannot be denied that as time goes on the breach between the supporters and the opponents of the theory shows no signs of closing. On the contrary, it is distinctly widening, and on examination it would appear that it is doing so far more as a result of the increased strength, in numbers and argument, of those who oppose the theory than of any gain in the evidence advanced in its favour by those who support it.

Legitimate criticism of the theory of relativity has taken two directions, namely, an examination of the mathematical processes involved in its derivation and of the experimental evidence adduced in its support. On the mathematical side, Painlevé has endeavoured to show that Einstein's conclusions and formulæ are not the only conclusions and formulæ which may be derived from his postulates. The same assumptions, according to the French mathematician, lead equally well to other results. In one direction they take us back to conclusions identical with those of classical mechanics; in another they yield a result diametrically opposed to Einstein's interpretation; while in a third they lead to a system of mechanics of a nature more startling even than that of relativity. On the experimental side a volume of criticism of a very damaging nature is being accumulated. It may be recalled that Einstein derived inspiration for his studies from the failure of the Michelson experiment of 1887 to record the orbital movement of the earth relatively to the ether. If the ether is stagnant, as it was supposed to be until Einstein provided a means of dispensing with the conception of ether, stagnant or otherwise, then the interferometer used by Michelson should have been capable of measuring the earth's velocity of 19 miles per second relatively to it. That no velocity at all was recorded is one of the corner stones of the theory of relativity, for that theory expressly states that there is no such thing as absolute velocity, and therefore no possibility of measuring it; that all velocities are relative, and that absolute rest does not exist anywhere in the universe. It was suggested long ago that the negative result of the 1887 experiment was due to the fact that, while the general body of the ether was stagnant, a layer of it was dragged along by the rough surface of the earth and partook of its velocity, so that at the ground level there would be no relative motion. Last year Professor Miller repeated the experiment at Mount Wilson Observatory at an altitude of nearly 6000ft. and obtained a definite indication of an "ether drift" of about one-tenth of the full amount. The experiment is to be repeated with improved apparatus, but even already the very foundations of Einstein's theory have, in the opinion of some, been badly shaken. Of the tests applied to the theory, that to which its supporters have called greatest attention is the explanation which it affords of the rotation of the perihelion of Mercury. The major axis of the orbit of this planet is not stationary, but is slowly rotating about the sun as pivot at a rate which, according to the best observations, is about 41.6 seconds of arc per century. This movement has been variously explained without departing from the laws of classical dynamics, as, for example, by assuming the existence of an unknown planet, Vulcan, between Mercury and the sun, or by changing the index in the denominator of the inverse square law of universal gravitation from 2 to 2.00000016. The theory of relativity by itself is capable of accounting for the perturbation and on calculation it is shown that it should be 43 seconds per century. This close agreement seems very favourable to the soundness of the theory; but Professor Poor, of Columbia University, has recently attacked the question in a very trenchant manner in a volume entitled "Gravitation *versus* Relativity" (Putnam) and has destroyed much of the significance of the agreement. The orbits of Venus, the Earth and Mars all show rotations of the perihelion, although they are much less than that of Mercury. The observed values and the values calculated by the Einstein theory are, in the cases of these planets, very far from being in agreement. In the case of Venus the observed and the calculated rotations are actually in opposite directions. Professor Poor has also subjected to examination the alleged evidence in favour of the theory of relativity afforded by the eclipse photographs taken in May, 1919, by British astronomers. Einstein argued that the light from the stars would be deflected from a straight line when passing the sun, and calculated the amount for several stars. It came in the case of the seven stars chosen for observation to between 0.32 and 0.88 of a second of arc. In two instances the observed values after sundry corrections agreed with the calculated to within 3 per cent. In others, however, the error varied from 11 to 60 per cent. That the observations and all the corrections were accurately taken and applied is a matter open to considerable doubt; but the gravamen of Professor Poor's criticism is to be found in his statement that, while attention has been widely directed to the close agreement between the observed and calculated *amounts* of the shifts, no attention has hitherto been called to the fact that the *directions* of the shifts were very far from agreeing with the Einstein values, being in one case as much as 36 deg. out. The Fizeau experiment and the shift of the lines of the solar spectrum have also been discussed by Professor Poor, with results equally discrediting to the theory of relativity.

The criticism levelled against the relativity "tests" by Professor Poor charges Einstein and certain of those who have actively supported him with having "selected"—a human failing against which the scientific mind is presumed to be armed—the "evidence" in favour of the theory, whilst facts and figures telling against it have been ignored and data leaning, in Professor Poor's view, neither to one side nor the other have been made to support the theory. Such charges are fortunately based on matters of fact and should therefore lend themselves to speedy settlement. To the impartial observer it would appear that the case against relativity is very strong. It would, in fact, be almost convincing were it not for the knowledge that on the opposite side is ranged the support of a large body of men whose opinion in the matter cannot be ignored. Is it possible that these men can have allowed themselves to be hypnotised by a specious theory, that their judgment has been warped and their eyes blinded? We can hardly think so. On the other hand, the alacrity with which many have accepted Einstein's doctrines on the strength of alleged evidence involving the measurement of abstruse quantities of a very minute nature is not above suspicion, for it suggests that, faced with an ever-growing and almost intolerable complexity of properties demanded of the ether, scientists have accepted relativity, not for the sake of the reasonableness of the theory, but because it afforded a means of escaping from the conception of that intangible, perplexing fluid.

Institution of Mechanical Engineers

DREDGING AND RECLAMATION.

Members of the Institution of Mechanical Engineers met at Storey's-gate on Friday, December 15th, to discuss a paper, by Mr. Gascoigne Lumley, on "Reclamation Plant and its Operation." The President, Dr. Hele-Shaw, took the chair, and in opening the proceedings announced that the Duke of York had accepted the invitation of the Institution to become an honorary member. After the usual business had been transacted, Mr. Lumley read his paper in much the same form as we reprint it on page 659.

The discussion was opened by Sir Arthur W. Clarke, Trinity House, who said that he had spent some time on the Continent with the idea of studying the systems adopted there in dredging and reclamation work, but he learned there more about what to avoid than what to do. In fact, he came to the conclusion that continental engineers could teach us nothing in the building of docks and harbours. In Amsterdam, however, he saw a very fine piece of dredging work, which was being carried out with a bucket dredger. It was, he said, easy to understand why those concerned with the Thames navigation should take a deep interest in dredging, when it was appreciated that the maintenance of the waterway entailed the annual removal of 4,000,000 cubic yards of material. The disposal of this spoil had always been a serious problem, and in the past, before it was taken out to sea and dumped in the Deeps, the accumulations of dredgings were a source of much trouble. Many years ago Duckham built a little boat for pumping spoil ashore and set it to work on the mud dredged from the docks. The mud accumulated in great heaps round about the docks and covered valuable land. On the other hand, however, Mr. Williams had converted the useless marshes at Dagenham into a valuable site by reclaiming them with refuse dredgings, &c.

Mr. L. H. Savile, Admiralty, pointed out that no two dredging or reclamation jobs were precisely alike, and that the plant required for each should be considered individually. Although the operation of dredgers was rather in the nature of civil than mechanical engineering, the design of the machinery itself was essentially the mechanical engineer's work, and in order to help them and the manufacturers to produce the most satisfactory plant they should be told of all the troubles and difficulties experienced in running it. It would, in fact, be very helpful if more papers dealing with failures were read before the technical institutions. The reason why the author had found such a rapid rise in the fuel consumption when the pipe line was extended beyond 3500ft. was, he thought, to be discovered in the fact that the machinery was not sufficiently powerful for its work. A speed of 12ft. per second was not, he considered, sufficient to ensure the current of water carrying the spoil in suspension, and the speed should not be allowed to fall below 14ft. per second. Mr. Savile suggested the arrangement of a helical guide, of angle or ⊥ iron in the pipe line, to give the water a rotary movement and thus assist it in keeping the sand in suspension. He thought that the pumps used by the author at Lagos were slightly overloaded, and asked how it was that the suction was only equivalent to 15in. on the gauge, a fact which might be accounted for by air pockets in the pipes. Mr. Savile gave some particulars of his experiences in Bombay, where 14¼ million cubic yards were dredged annually, and said that great difficulty was experienced in dredging soft clay through the breaking of the cutter shaft, which was as much as 11in. in diameter. By increasing the shaft to 13½in., however, the trouble was overcome. He had found a water speed of 14ft. per second satisfactory for the discharge pipe line.

Sir Cyril Kirkpatrick, Port of London Authority, confined his remarks chiefly to the reclamation, or disposal, side of the question, and explained, by means of a map, how the dredgings from the Thames are conveyed a distance of 67 miles before they are dumped in the Black Deep in the mouth of the river. In this connection he pointed out how a change of the dumping ground to another deep, only one mile further out, on account of the fear that the Duke of Edinburgh Channel might silt up, had resulted in an increase of the disposal expenses by £4000 a year.

It was often urged, he said, that the spoil might be used for reclaiming low-lying land; but, as a matter of fact, such a scheme was seldom a commercial proposition. Thus the cost of the land might be put at some £300 an acre, and if it were filled to a depth of 12ft. the cost would work out at 3½d. per cubic yard. On the other hand, the present system of disposal cost only ½d. per cubic yard. It might be possible to fill in behind a revetment and pile the spoil to a greater height, but experience at the London docks, as had been mentioned by Sir Arthur Clarke, showed that the latter policy was unsound. An example of the useful employment of spoil was given by the use of about 22 million cubic yards of material, dredged from the harbour at Vaalhavn, near Rotterdam, for the reclamation of a public park 5 miles distant. Sir Cyril thought that the continental term "spouting dredger" very appropriate for the class of plant under discussion.

Mr. F. M. G. Du-Platt Taylor showed some lantern slides of dredging operations on the Mersey bar, some of which illustrated very graphically the ability of modern dredgers to remain at work in quite a considerable seaway, and said that when working at the rate of 3000 tons loaded in half an hour, the dredging costs worked out at ½d. per ton. Dredging sand was, he said, a simple matter as compared with working in mud, as the sand quickly separated from the water in the hoppers, while there was a tendency for the mud to be washed overboard again as quickly as it was raised. He had, however, achieved some success by using a suction orifice 8ft. long by only 1in. wide, and then managed to get 20 per cent. of the mud pumped to remain in the hopper.

Commander J. Percival said that he, as a seaman, had been consulted in 1903 concerning the bar at Lagos, Nigeria, which at that time had only 9ft. of water over it. In the light of experience at Liverpool he recommended that dredging should be carried on during six months of every year, and now there was 27ft. of water over the bar Before the spoil raised during this work was filled into the surrounding swamps the locality was infested with mosquitoes, and was decidedly unhealthy; now it is comparatively salubrious. During some of the work it was necessary to send the spoil as far as 2000ft. inshore, and a second pump was then used in series with the main pump.

Mr. Nicholas Gedye emphasised the difficulty of dredging mud by means of the suction type of dredger on account of the slowness with which the material settled out from the water in the hoppers, and said he thought that for economy's sake the depth of cut with a drag cutter ought to be greater than 18in. He agreed with the author's recommendation of the Cederval type of gear for excluding grit from bearings, which, he said, had been proved on the Tyne to be very effective for bottom tumbler bearings, and made a few remarks on the removal of 1,600,000 tons of sand from Ostend Harbour, which had accumulated on account of obstructions, including the Vindictive, sunk during the war. The work was carried out by British dredgers, together with a German one that was salved from the bottom of the harbour itself, and was completed between the months of May and August.

Mr. R. J. N. Wilcox, as an example of the difficulties which might be experienced in dealing with clay, said that he knew of a case where the dredger was working in brown boulder clay. This material filled the hoppers to the extent of about one-half by depth and one-third by volume, but had, nevertheless, to be dug out again with spades. He commented on the fact that while the Dutch engineers, who have been successful in reclaiming land with muddy sand, employ open pump impellers with straight arms, the Americans use shrouded and armoured impellers.

Mr. J. Thom and Brigadier-General Magnus Mowatt also joined in the discussion, which was briefly replied to by the author, who said that he recommended a depth of cut of about 18in. when working in hard sand.

Steam Boiler Matters.

MR. STROMEYER'S annual report to the Manchester Steam Users' Association is always read with interest. The author not only has a knowledge of boiler design and management which can hardly be equalled, but he takes a generous view of his subject and frequently deals with correlative subjects. In this year's report, for example, we find some notes on "Fatigue Testing" and an interesting investigation into the specific heat of steam. After many months of work and a close examination of the literature of the subject, Mr. Stromeyer believes that he has found a reasonably fitting formula for the specific heat of steam, which, with his remarks about it, we shall present in a future issue. To-day, on page 672, we reprint that section of his address which deals with boiler design. It is worthy the attention of those blessed—or cursed—with an inventive turn of mind. Years ago Osborne Reynolds showed that heat transmission increases with the velocity of the hot gases. By employing that principle we can equalise the temperature differences on either side of a heating surface by using forced draught: but if we attempt to adopt this plan we find ourselves brought to a boiler design in which the velocity of the gases has to be increased as their temperature falls. Such a boiler ought to turn out to be smaller and more efficient than any in use. It would be interesting to see if it lends itself to practical design.

In his notes on "Fatigue" the author discusses the need for experiments on combined static and fatigue stresses. There is probably no engineering structure in which such a combination does not exist. Mr. Stromeyer's remarks lead to the conclusion that we may have either high static and low fatigue stresses or *vice versâ*, but we must not have both high together. For example, in a bridge which has normally to bear high static stresses we must not add high fatigue stresses, or, from the reverse point of view, we may put very high fatigue stresses into a piston-rod because the static stresses are very low indeed. The subject seems to be one well worth detailed examination. "Fatigue tests," writes Mr. Stromeyer, "may, of course, be used for the purpose of demonstrating the excellent qualities of new materials; but even then they ought to include permanent stresses. The present primary object of fatigue testing, however, ought to be the establishment of laws (in diagram form) in order that when failures do occur, for which the number of alternations is approximately known, the intensity of the local stresses, which can rarely be calculated, can then be easily read off."

In another section of the report Mr. Stromeyer describes tests on two old iron boilers—sixty years old or so. It is quite astonishing how well the old iron stood up to heavy hydraulic pressures, and it is particularly notable that cracks round rivet holes—all punched—did not extend during their working life. Within its limitation it would appear that really first-class Yorkshire iron was hard to beat for boiler construction. We hope to reprint this section also in a future issue.

Finally, a word or two must be said about the important question of boiler examination, with which Mr. Stromeyer deals at some length. It will be recalled that some months ago a boiler, which had been unquestionably improperly used, failed through the bursting of a tube owing to heavy incrustation, with the result that one man was killed. The Commissioners held an inquiry and a responsible person was heavily "fined." It turned out that the boiler inspectors had not caused the boiler to be completely scaled, and as an immediate result the Home Office proposes a change in the wording of the Factory and Workshops Boiler Reports. The custom that has prevailed for many years is that a "competent person" makes a report that a boiler is safe for a certain working pressure. The Factory Inspector notes the report and himself reports that the boiler was scaled and was accessible, and then gives permission for it to be used. Under the new rule the onus apparently will no longer lie upon the "competent person," but upon the Inspector himself, who will have to "certify" that the boiler was put into proper condition for examination, and who may decide whether it is to be used or not. Mr. Stromeyer does not believe that the change will be beneficial, as it will rob boiler owners of the valuable reports about the condition and working of their boilers which they used to receive from the insurance companies. He writes:—

"There can be no doubt that from an Inspector's point of view it will be very convenient to have a bureaucratic regulation compelling the boiler owner to prepare his boilers 'spick and span' in anticipation of the arrival of the Inspector; it will also please him to be in a position to certify whether the owner has carried out the provisions of the Act in accordance with his personal interpretation; and it should also be most gratifying to the Inspector to certify about himself that he did his work thoroughly. But how about the boiler owner? He is responsible for the competence of the Inspector he employs; he is also responsible for the thoroughness of the Inspector's work, and can be fined if the Inspector turns out to be incompetent, negligent, or worse, even if the Inspector should certify himself to have done his work thoroughly.

"From a boiler owner's point of view an Inspector's certificate about himself has about as much value as a lunatic's certificate about his sanity. It is the boiler owner who, in future, will be put to heavy expenses as regards scaling, cleaning and preparing his boilers, in order to guard against the possibility of the Inspector's saying that the scaling and cleaning were not in accordance with his personal interpretation of the Act. Boiler owners have a remedy in their own hands. If a boiler insurance inspector, or his company, considers a boiler sufficiently safe for insurance (a very severe money test on an important subject), then the owner has a very definite assurance in hand as to the safe working pressure, and he can now employ his own servants or an outside 'competent person,' who will make assurance doubly sure by a thorough inspection, during which he will see for himself whether or not the scaling complies with the Act. This would, of course, mean an extra fee, or the time of an engineer employed at the works; but such an expense would be a trifle compared with what would often be unnecessary work.

"The report form, even as it stands, gives to the irresponsible 'competent person' of the Act, *i.e.*, the Inspector, practical immunity from censure in case of an inquiry under another Act—the Boiler Explosions Act, 1882—while the owner, who is responsible for the doings of the 'competent person,' as far as the Factory and Workshop Act is concerned, is, by the wording of the report form, made a defenceless victim in case of a Board of Trade inquiry under the other Act. In fact, although the Act is quite clear in its intentions to throw the whole responsibility on the owner as regards maintaining the boilers in a safe condition, the report form, which in several respects is contrary to the Act, strains every point to make the Inspector irresponsible and to saddle all the blame on the boiler owner in case of an explosion due to negligent inspection. Our members are, of course, safeguarded, because we are under a contract as regards reliable inspection, without reservation.

"These views reveal even more clearly than does the wording which will be adopted in the report form, that the Home Office evidently intends to give boiler inspectors a position which will not be far below that of Factory Inspectors as regards controlling the actions of boiler owners. It will remove all risk of their being blamed under the Boiler Explosions Act, but the boiler owner will suffer.

"The first effect of the change will be imperceptible, but very soon, when the Inspectors realise the power which has been placed in their hands, it would be expecting too much of human nature if they did not use it. We have seen during the war how very quickly even the most humble of our friends grows to be an inflexible bureaucrat as soon as he has to administer an Act of Parliament."

It will be seen from this brief summary of its contents that Mr. Stromeyer's report is this year of exceptional interest, and that it covers a greater number of subjects than usual.

Hot-Water Boiler Wash-Out Systems.

On American railways extensive use is made of systems for washing out locomotive boilers while hot, and refilling them with clean hot water, thus expediting the process and avoiding trouble due to allowing insufficient time for the boiler to cool for cold-water washing, and for heating up the fresh charge of cold water. Many modern engine-houses are fitted with special apparatus for this purpose. At the annual meeting of the Mechanical Division of the American Railway Association, a committee reported as follows:—

The cost of boiler maintenance can be very materially reduced and the maximum efficiency of the boiler more nearly obtained by the consistent use of hot-water wash-out and fill systems. In the use of hot water, in order to be effective for the loosening of scale and washing out mud from the interior of the boiler, it should be under a pressure of about 130 lb. per square inch, and at a temperature of about 150 deg. Fah. This force and temperature will quite effectively remove scale and clean the boiler. There are three general types of wash-out and fill systems in use.

(1) The ejector type, in which wash-out water is slightly heated and placed under pressure by injecting steam into it through a suitably designed nozzle. This is the simplest and least expensive type, but appears to be the least desirable.

(2) The pump and heater system, where the water is heated in an open or closed heater, distributed through a pipe line in the engine-house and forced under a pressure of about 130 lb. into the locomotive through a hose and nozzle. This type is fairly effective, and can be installed without violating any patent rights. For a medium sized terminal, such a system with two water tanks, one wash-out and one filling pump and two pipe lines into the engine-house, will afford wash-out water at 150 deg. and filling water at 200 deg. Fah. at a small operating expense. Where exhaust steam is available for heating water, this type is excellent for a medium-sized terminal.

(3) The blow-back type, where the steam blown off the locomotive is utilised to heat the wash and filling water. Such systems which also provide for the automatic tempering of the water used in washing out and the use of a circulating line to keep the water alway hot in the engine-house lines, are protected by patents. This system is the most effective one, and provides wash-out water at all times of the proper temperature, and re-used water and steam blown off from the locomotive instead of wasting same.

The committee earnestly urges upon the managements of the railroads the importance of installing hot water wash-out and fill systems, thereby effecting economies and efficiency with little expenditure of capital.

IT is reported from New York that plans for the standardisation of ship construction and operations, suggested by Mr. Hoover, Secretary of Commerce, were recently presented to the American Marine Association. The suggestions made were:—(1) That there be formed a central committee, or "American Marine Council," made up of representatives from every association or group interested in, or connected with, American merchant marine problems; (2) That this Council be given the responsibility for a comprehensive survey of the facts to determine (*a*) the prevalent wastes in current practice, both commercial and engineering, and (*b*) the extent to which simplification and standardisation may be practically applied throughout all phases of the industry, and (*c*) that a definite time be set for the completion of the survey and for another general meeting to receive the report and act on its recommendations. It was decided to appoint a committee of five or more, to submit a report to the American Marine Association, outlining a plan and scope of ways and means for accomplishing these standardisation measures.

Manchester Wireless Broadcasting Station.

WHATEVER the future may have in store for wireless telephony—and nobody doubts that this method of transmitting messages has great possibilities—"broadcasting" introduces problems which are as yet unsolved. In the United States where "listening in" has developed into something like a craze, there are now over 500 broadcasting stations, which are operating without reference to one another, and the result is confusion and annoyance. Profiting by this experience, it has been deemed necessary to limit the number of broadcasting stations in this country and to co-ordinate their operating conditions in order to preclude, as far as possible, similar troubles. The British Government indicated, through the Postmaster-General, its willingness to sanction the dissemination of music and speech by wireless telephony, only upon condition that broadcasting was conducted by one responsible authority. The formation of the British Broadcasting Company, which embraces a group of about half a dozen of the largest electrical manufacturing firms, was the result of this decision. Although the number of firms in this corporation is at present small, it is not intended to act as a monopoly. Any *bonâ fide* British manufacturer can join the larger company on quite nominal terms, and the expense of maintaining the broadcasting stations, of which there are to be at least eight in various parts of the country, is to be borne partly by the Government and partly by the manufacturers concerned.

The great industrial centre in the north-western part of England has been fortunate in having at its disposal the research department of the works of the Metropolitan-Vickers Electrical Company, Limited, in Trafford Park, Manchester. For some time, this company has been actively engaged in the manufacture of wireless telephonic apparatus, including an inexpensive crystal set and a two-valve set with loud-speaking attachment, both of which have been approved by the Postmaster-General. We had an opportunity recently of inspecting the department of these works which has been set aside for this branch of its activities as well as the broadcasting station, views of which are given in the accompanying engravings. The power for the radio transmitting set is supplied by a small generator in the works power-house at 440 volts, 50 cycles, three-phase, and this is employed to drive a triple set, consisting of an induction motor, high-tension generator and exciter, supplied by Newton Brothers, of Derby—Fig. 1. The high-tension generator is rated at 2.5 kilowatts at 5000 volts, and runs at 1500 revolutions per minute. Two of these sets are installed, and a complete change-over of drive and supply can be effected in emergency by throwing over a single switch from one side to the other. Filter circuits are provided in connection with the high-tension generator to remove the commutator ripple. The field of the high-tension generator is fed from the exciter through a potentiometer-type field regulator, which enables stable adjustments to be obtained down to very low voltages, such as are occasionally required for test and experimental purposes.

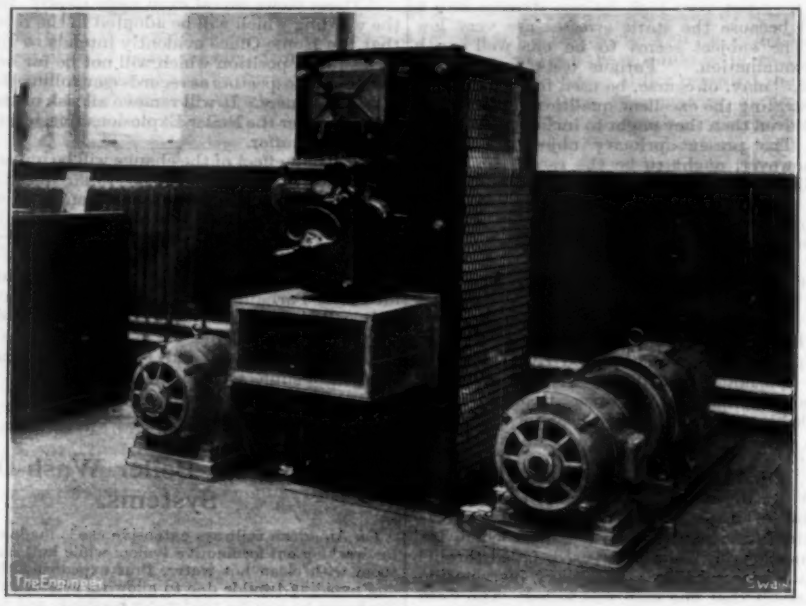


FIG. 1—HIGH TENSION GENERATING SET FOR "BROADCASTING"

The transmitter panel—Fig. 2—which was installed by the Radio Communication Company, of London, employs Mullard 0–500 valves. The high-tension direct-current supply at 5000 volts is fed directly to the anodes of the valves, and protective gear is provided to protect the generating set against short circuits. The transmitter is installed in a small transmitting room. While a special listening station is provided about 7 miles from Trafford Park, the character of the modulation is also checked in the transmission room. The filament of the transmitting valves is heated from a 30-volt battery. An artificial aerial, to enable tests to be carried out with a minimum of interference with other users of instruments, has been provided.

The studio—Fig. 3—is accommodated in a room adjoining the transmitting room. The walls are draped with hangings and the floor has been carpeted to avoid the resonance and echo which are encountered from the floor and walls of ordinary rooms. The equipment comprises a grand piano, with a player attachment, a new Edison gramophone of the latest diamond-disc type, and a cabinet gramophone. The studio is connected to the transmitting room by multi-core cables, which may be used for microphone or other control circuits, these latter being run in a separate cable to avoid inductive interference.

The music and speech from the studio is picked up by microphone or other apparatus supported on stands. These sounds are given preliminary amplification in the studio and passed through the microphone cable to the transmitting room, where further amplification is carried out before the amplified currents are impressed on the aerial. The aerial used at Trafford Park is of the cage type, and it is suspended between the top of the water tower and the highest point of the main works building. The lead-in is taken from the centre of the main aerial, and drops into one of the research laboratories. Each cage has six wires supported by loops, the average height being about 160ft. The station has worked, since its inception, on 800 watts, but the power is being increased almost immediately to 1500 watts, the full power for which it is licensed.

The small experimental station at Hale is capable of transmitting 100 watts. A single-phase induction motor on the Altrincham electric supply, driving a high-voltage generator of 1500 volts at 1500 revolutions per minute, is used with an exciter. This station acts partly as an independent experimental station and partly as a control for the main broadcasting station, and is equipped with various receiving sets for listening-in. The aerial is 150ft. long and comprises a triple wire with 12ft. spreaders at a height of 75ft.

The cheaper of the two sets of apparatus constructed by the firm is a crystal receiving set, which can be used to listen-in within a radius of, say, 10 to 12 miles. It consists of three parts, the tuner, the detector and the telephone. The tuner is operated by a handle, and enables the set to be adjusted to receive messages from any station within its range. The detector is a special type of crystal, which changes the electrical waves received by the aerial into electric currents which produce the sound in the telephone. The valve set is much more expensive. It is mounted in an outer case, into which are fitted a two-valve receiving unit and a battery box, thus forming an entirely self-contained receiving set. There is also space in the case for a note-amplifying unit, if required. With the two-valve receiving unit the user can hear a broadcasting station at a distance of 50 to 100 miles or more. By the addition of a note-amplifying unit, the makers claim that the range may be still further increased up to about 200 miles, using head telephones, or for distances up to about 50 miles a loud-speaking telephone can be used. The receiving unit comprises a high-frequency amplifying valve, a detector valve, an aerial tuner, and a "tunable" transformer. Adjustment can be effected by manipulation of the tuning handles, and there is a rheostat for regulating the filament current of the valves.

The broadcasting station is at present being operated each evening from 6 p.m. till 10 p.m., and the programme is of a miscellaneous description, including children's stories, late news from the usual agencies, operatic music, lectures, &c. We had an opportunity of listening-in to one of the programmes at the above-mentioned station at Hale. A two-valve receiving set, with a two-valve note amplifier was used, and the results were generally very satisfactory. There was, however, some slight interference with the programme, due to an extraneous intervention. This implies no disparagement of the Broadcasting Company's apparatus, but rather the need for an improvement in the broadcasting system, which will render such interference impossible. There is still room, too, for improvement in loud-speaking apparatus generally which tends to "thicken" the articulation. This is a blemish which will no doubt be remedied in time. Similarly, it may be expected that valve sets will be constructed in which the use of accumulators will be avoided where other sources of electricity are available.

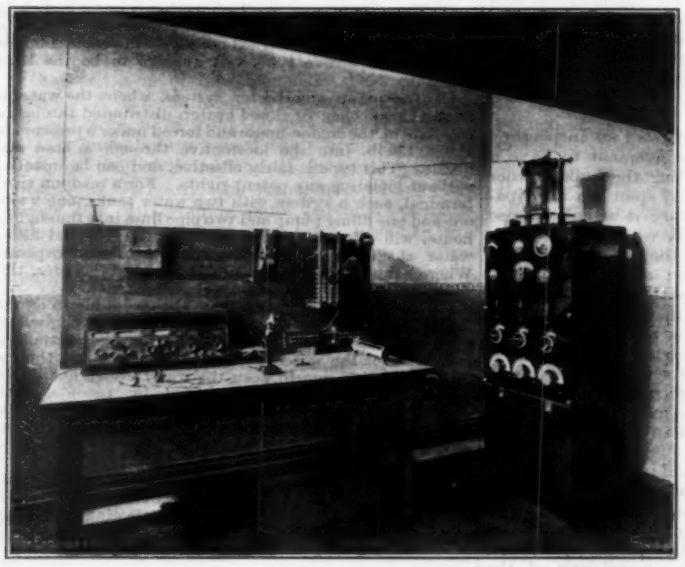


FIG. 2—TRANSMITTER PANEL

FIG. 3—MUSIC STUDIO

ALTHOUGH since the war attempts have been made to repair the damage caused to the main roads by the transport of artillery and the frequent passage of heavy lorries, nevertheless, much remains to be done in order to fit the main roads of France for modern traffic. This fact has been acknowledged by the Chamber of Deputies, which has now passed a Bill by which large numbers of main roads are to be relaid. The Bill applies both to departmental and national roadways, and provides for the relaying, with all modern improvements, of 7500 kiloms. of national roadways and a similar distance of departmental roads. A State subsidy will be granted to the departmental authorities for the latter category. Not only the industrial importance of a route, but also its interest from the tourist's point of view have been studied in making a selection of the roadways to be relaid.

British Sleeping Cars for the Continent.

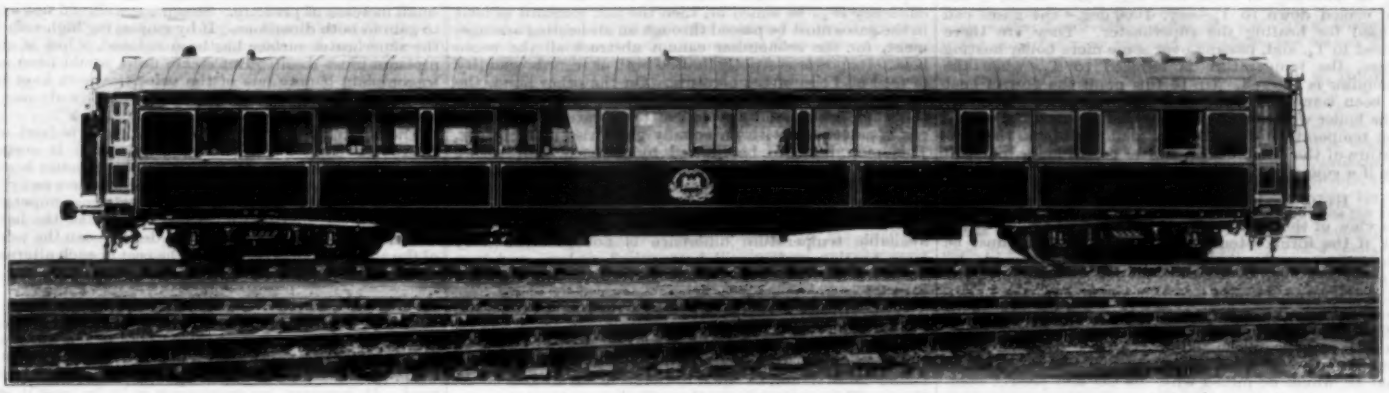
SOME railway coaches of unusual interest to British engineers, which have just been put into service by the International Sleeping Car Company on the run from Calais to the Riviera *vid* Paris, are illustrated by the accompanying half-tone engravings and line drawing. The new cars, built at Leeds by the Leeds Forge Company, Ltd., represent a noteworthy advance in sleeping car construction, on account of the extensive use of steel castings in the construction of the underframes. Large steel castings are employed at each end in order to reduce the number of small parts which would otherwise be required to carry the many fittings necessary on a car, that must be capable of being coupled with the rolling stock of so many European countries. These castings were made in America to the designs of the Leeds Forge Company, approved by the Wagons-Lits Company. The bogie frame is also a single steel casting, so designed that the numerous separate lugs and brackets generally required for carrying the brake gear, &c., have been dispensed with. The pin-holes in this casting are provided with hard steel bushes. The body framework is of steel throughout, built up on pressed steel pillars, and a special quality of ¼in. steel sheets made by Lysaght's has been used for plating the sides. The rivets are all countersunk on the outside. In putting the coaches together complete sides and roofs are built on jigs and assembled as units, and a specially contrived framework used for lifting these large flimsy units from the jigs and lowering them on the underframes.

As will be seen from the accompanying photographs of the interior, the finish is of the very highest class. All the interior woodwork is of polished mahogany, made in panels or sections to jigs, and is interchangeable. The floors are made of key flooring steel sheets covered with composition, over which there is laid felt, cork linoleum and carpet. The seats are upholstered in velvet.

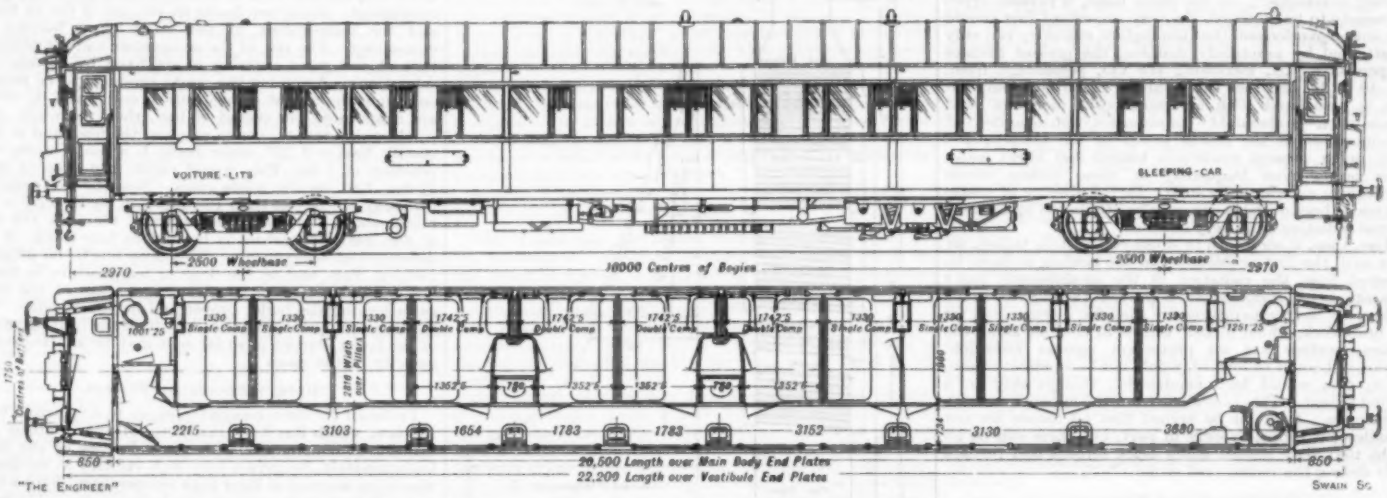
The coaches each carry sixteen passengers and comprise eight single-berth compartments and four double-berth compartments. Six of the single-berth compartments are provided with communicating doors, which can be locked from either side. The first coaches placed in service by the International Sleeping Car Company had four berths in each compartment; but since they were superseded, each compartment has been provided with two berths. The new coaches are thus the first to be provided with single-berth compartments. When one considers the length of run for which these cars are used and the fact that many of the travellers are business men travelling alone, who wish to make use of much of the time spent on the journey on their private business affairs, the great advantage of single-berth compartments is evident. Dressing rooms with washing facilities are arranged between the two-berth compartments. Each single-berth compartment is provided with a wash-basin cabinet containing a tip-up wash-basin supplied with hot and cold water.

The cars have been built to the designs of the Leeds Forge Company as approved by M. Doassans, chief engineer of the International Sleeping Car Company, and to his inspection, carried out under the supervision of M. Jault, agent réceptionnaire, from whom the builders have received considerable assistance.

Out of the forty cars ordered thirty-two have now been delivered, and several are being used for the P. and O. express from Calais to Marseilles, but the service is now being extended to the Calais-Mediterranean express, and in order to inaguurate this service two special trains were run by the International Sleeping Car Company last Saturday from Calais and Paris respectively. No special efforts were made to establish records, though the trains travelled throughout the run at speeds higher than is usual for this service. The guests were all much impressed by the comfort of the new cars and by the easy running of the vehicles, especially over the notoriously uneven track close to Calais.

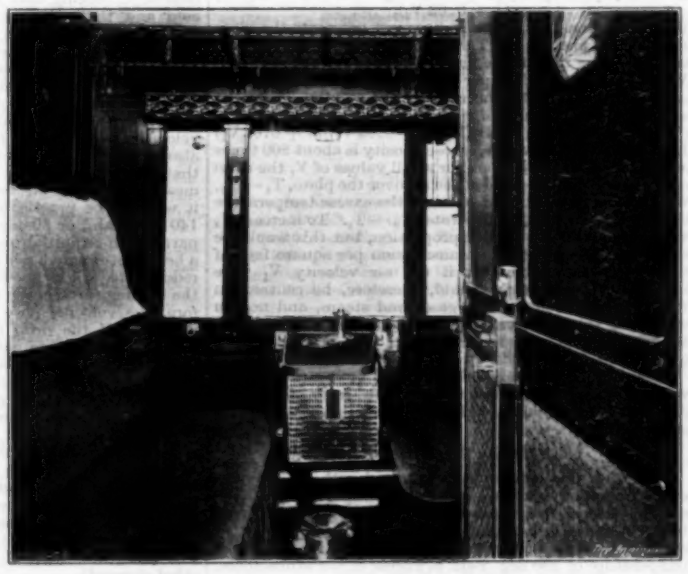


16-BERTH SLEEPING CAR FOR THE INTERNATIONAL SLEEPING CAR COMPANY



SIDE ELEVATION AND SECTIONAL PLAN OF 16-BERTH SLEEPING CAR

SINGLE BERTH COMPARTMENT



DOUBLE (SUPERPOSED) BERTH COMPARTMENT

Principles of Boiler Design.*

The principles of boiler design with special reference to economy appear to be engaging the attention of several makers, and it has, therefore, been deemed opportune to review the leading principles involved. The diagram below, if placed vertically, represents a water-tube boiler; if horizontally, a Lancashire or similar boiler. Heat is generated in the furnace. If the combustion is perfect, with little excess air, the furnace temperature T_1 may be 3000 deg. or even 4000 deg. Fah. When it has been cooled down to T_2—say, 1000 deg.—the gases can be used for heating the superheater. They are there reduced to T_3, and, passing over some more boiler heating surface, the temperature is reduced to T_4, when the economiser is entered. Up to this point the flow of heat has been somewhat hampered by the high temperature of the boiler water or the superheated steam. The economiser temperature is much lower than these, and the temperature of the air in the air heater is still lower, particularly if a counter-current be adopted.

High Furnace Temperature Effects.

In view of the injury done to boiler parts and to brickwork if the furnace temperature be high, as it must be with perfect combustion, the suggestion was made by me some years ago to resort to double combustion. The fuel in the furnace would be burnt, not to CO_2, but to CO. The resulting temperature could then not exceed about 2500 deg. Fah. and the temperature curve in the boiler would be as indicated in the broken line. Having cooled down the gases to, say, 600 deg. or 800 deg. at T_2, additional air would be mixed with the CO and perfect combustion would then result, but again the temperature would not exceed about 2500 deg. Fah. The heating surfaces would have to be proportioned both to the relative weights of the CO and CO_2—say, 28 to 44—and to the respective decreases of temperature. Undoubtedly this arrangement would present difficulties when using customary types of boilers, but if entirely new types are to be evolved, the above possibilities should not be entirely overlooked; on the other hand, if present types are merely to be modified, the very important fact should also not be overlooked, that the highest efficiency can only be attained by practically doubling the present furnace temperatures, *i.e.*, increasing the CO_2 percentage from, say, 10 to 20, and that this doubling of furnace temperature is associated with an enormously increased heat transmission—sixteenfold—for radiation from incandescent fuel increases at the fourth power of the temperature. Even under present conditions bulged and burnt water tubes occur most frequently in those boilers whose efficiency is exceptionally high. In the absence of grease and scale these mishaps can only be attributed to the very intense radiation from very hot fires.

Here, then, if we return to single combustion boilers, we meet with the first problem. Can the heating surfaces be screened from the radiation of the incandescent fuel? Separate brick furnaces have proved themselves to be useless, for the temperatures are then too intense even for the brickwork, which melts. Sheets of cold air along the heating surface are no protection against radiation. Smoke, if it could be formed, would not be a perfect screen, for it, too, would be incandescent, though only to a limited extent. This is evident from the experiences with oil burners. It might be argued that oil flames are not incandescent solids, or only in part, but there can be no doubt that they melted many brick screens and furnace walls during the recent coal strike.

Convection and Velocity.

Assuming that the radiant heat of the furnace has been disposed of one way or another, we are face to face with the question of convection. Let there be two fluids of different densities on both sides of a plate—heating surface—then, neglecting the very slight resistance offered by the plate to the passage through it of a certain quantity of heat, H per hour, it appears that

$$H = C\,(T_1 - T_0)\,D_1\,(1 + 0.02\,V_1) = c.\,(T_0 - T_2)\,D_2\,(1 + 0.02\,V_2).$$

Here C is a constant which is, however, not quite the same for all gases and fluids. T stands for the various temperature, T_0 being that of the plate, D stands for densities and V for velocities in feet per second. The two right-hand expressions determine the ratio of the subdivision of the available temperature difference $T_1 - T_2$. The ratio is

$$(T_1 - T_0)/(T_0 - T_2) = (D_2/D_1)(1 + 0.02\,V_2)/(1 + 0.02\,V_1)$$

Let the one fluid be water, whose density is about 800 times as great as that of air, then for small values of V, the ratio of the excess temperature of the air over the plate, $T_1 - T_0$, would have to be about 800 times the excess temperature of the plate over that of the water $T_0 - T_2$. To increase V_2 would only increase this disproportion, but this would be diminished, and the heat transmission per square foot of heating surface increased, if the air velocity V_1 were increased. Our efforts should, therefore, be centred on increasing the velocities of gases and steam, and not on increasing the water velocity, except, of course, for circulating purposes and for liberating the steam as it is generated.

It could easily be shown that a minimum heating surface will be obtained if the temperature ratio $(T_1 - T_0)/(T_0 - T_1)$ is near unity. This is of importance as regards superheaters.

Costly Natural Draught.

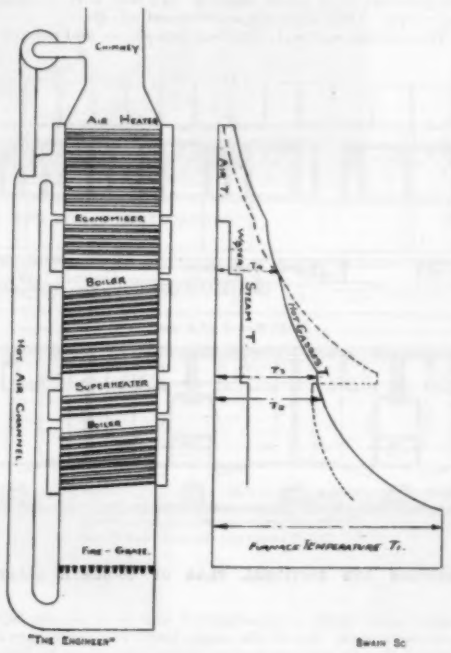
The other problem is that connected with the creation of the draught velocities. Assume that the waste products of combustion weigh twenty times the weight of coal burnt, this corresponding to a furnace temperature of about 2500 deg. Fah.; then if the waste gases have a temperature of 500 deg. Fah. in excess of the atmosphere, the chimney loss will be 20 per cent. In practice this loss can be reduced by improved stoking, but it will always be large. The same draught could be produced without a chimney and with gases cooled down to the surrounding temperature if a fan be used. Its cost in coal would be about one-thirtieth per cent. of the coal burnt. Why, then, do not fans replace chimneys? Because with present-day boilers the temperature of the waste gases cannot be reduced much below 400 deg. Fah. and because chimneys are necessary anyhow, to carry the gases above the house-tops. We may, however, repeat the question, pointing out at the same time that forced draught could be made to propel the waste gases at considerable velocities, and thus increase the boiler efficiency and overcome many economic resistances. Chimneys are very inefficient draught producers, the above-mentioned 20 per cent. waste passing up a 120ft. chimney producing a velocity of only about 10ft. per second.

It is desirable to consider these possibilities, but without going too closely into details, for these will necessarily depend on the design. Assuming that the very highest efficiency is to be aimed at, then the last remnant of heat in the gases must be passed through an air heating arrangement, for the economiser cannot abstract all the waste heat. Its power is strictly limited both as regards quantity of feed and rise of temperature. On the other hand, the air for the furnaces is practically equal to the weight of the waste gases, and any fall of temperature in the one gas is associated with an equally great rise in the other. This may have to be limited by furnace temperature considerations, but that is a matter for the designer.

Air Heaters.

If now we adopt an air heater we shall find that, as the available temperature difference is not great, a very large heating surface will be required, unless—and here we must fall back on the fan—we can produce a high velocity.

It has already been mentioned that the two gas velocities ought to be nearly equal, due allowance being made on account of the waste gases being hotter and lighter than the fresh air. This means that the sectional areas of the heater tubes should be equal to the sectional areas between them. This again means that the longer the tubes the closer will they have to be packed, and as the narrow slits would certainly become choked with soot if waste gases were to be forced through them, the better plan would be



to pass these gases through the tubes. Here, however, we meet with a serious, though not insurmountable, difficulty. Seeing that the waste gases will be relatively cold and that, therefore, soot deposits will be heavy, these would have to be scraped off, as is done in economisers. But internal scrapers are not easily arranged. They would probably have to work in succession. Perhaps, too, it might be advantageous to discard tubes and use sheets instead. It is not likely that moisture would condense on these surfaces, at least not if the waste gas velocities are high, for then the plate temperature would also be high. In economisers the metal temperature is that of the feed water; in air heaters it should be the mean of the two air temperatures. Probably, however, it will not be practicable to cool the waste gases below 140 deg. Fah., or 80 deg. in excess of 60 deg. This, compared with an initial temperature of 2500 deg., represents a heat loss of only 3 per cent. This loss can be still further reduced, as will be shown later. Having fixed the area of the heating surface, the relative sectional areas and, therefore, the velocities, we can determine the heat transfer in terms of the drop of temperature $T - T_0$. As the weight of the waste gases is known the heat abstracted from them is determined. This has to be compared with the power required to force the incoming air, as well as the waste gases, through their respective channels, and here a new problem presents itself for solution. Hypothetically there should be no loss of power except the trifle due to surface friction when, as in the Vena contracta, a fluid is forced through a suitable orifice. Unfortunately, whirling motions are set up every time that a restricted section is passed, and these absorb power. This loss cannot be regained. It may amount to 50 per cent. of the *vis viva* of the gas at maximum velocity. A nest of tubes, as is well known, will therefore absorb more power than flat-sided channels.

At this point consideration must be given to the weight of the air heater, to its size, to radiation losses, and to interest and depreciation. The gain due to the reduction of temperature must more than balance the cost for attaining this object.

Superheaters.

We may now consider the superheater, which is a necessary adjunct for modern engines. An estimate of the relative velocities will have to be made, as in the case of the air heater, but relative densities instead of temperatures will have to be introduced into the calculations. The steam velocities should be less than those of the gases, but both should be high. The loss of power in the main engine, due to drop of steam pressure in the superheater, should be estimated, also the increased friction in the steam pipes due to increased volume, or increased radiation, due to the adoption of slightly larger diameters. The simplest way out of this complication would probably be to start with the pressure required at the engine, and to make the boiler strong enough to bear the few additions. The problem is then reduced to the simple one of taking into account the increased cost of the boiler due to the small increase of pressure. Steam users should not expect to gain in both directions. If by employing high velocities the superheater surface has been reduced, a loss of steam pressure must result. But steam users would have cause to complain if only one of the velocities were kept high, for then there would be friction losses with only one half the possible gain.

The interesting problem has now to be solved as to where the superheater should be placed. It certainly cannot be placed next to the air heater, because here the temperatures are too low. The further we move away from the air heater, the hotter will be the waste gas temperature, the better the heat transmission, the smaller the heating surface required, and the lower, if desired, can the velocity of the steam and gas be fixed. The cost of each alternative would have to be worked out.

Economisers.

The question of an economiser is even more complicated than either of the above, because here it is a question as to whether it is at all desirable to fit one. Where the waters are sedimentary, economisers had better not be used. If, however, an economiser is to be used it seems highly desirable to reverse the usual procedure of proportioning it to suit the boiler, and, instead, the boiler would have to be designed to suit the economiser. The air heater, too, would be affected by the economiser. The position would be this: the air heater discharge temperature may not be less than, say, 140 deg. Fah. The hot air for the furnace should not have a higher temperature than, say, 400 deg. Fah. or whatever other limit may prove convenient. These two limits fix the size of the air heater and the temperature of the waste gases leaving the economiser. The size of the economiser and the temperature of the gases entering it are fixed by certain considerations. Assuming the waste products to be twenty-one times the weight of fuel burned and that 7 lb. of feed are evaporated per pound of fuel, then the waste gases would weigh three times as much as the feed, and as their specific heat is 0.237, water being 1, a rise of water temperature of 1 deg. Fah. would result in a drop of about $1\frac{1}{2}$ deg. Fah. for the waste gases. Now the feed temperature may not be less than 100 deg. Fah. and it may not be raised above the steam temperature, therefore the drop of flue gas temperature is limited to four-thirds of this difference of temperature. This drop has to be added to 140 deg. Fah. and to the drop of temperature in the air heater, and we arrive at the temperature of the waste gases leaving the boiler proper and its superheater. This discharge temperature practically fixes the heating surface of the boiler, except in so far as it may be affected by the velocity of the gases.

High Velocity of Flames.

Professor Nicolson essayed to apply to a full-sized boiler the law, which has been made use of above, about heat transmission increasing with the velocities of the fluids. Unfortunately, he gave a very high velocity to the flames, which, on account of their high temperature, deliver quite as much heat as is good for the boiler plates. The result of his experiment was disastrous. The more correct principle, the one advocated above, is to provide a large space and, therefore, a low velocity to the flames, and to increase this velocity as the temperature decreases, and with it the heat-transmitting power. Roughly speaking, the velocity of the gases should increase as their temperature is lowered. They should also increase with each decrease of density, say, from water to steam. In a sense the heat transmission per square foot of heating surface should be constant for the whole boiler.

Reductions of Furnace Temperatures.

There is yet another matter which should be considered in the design of any new type of boiler. The suggestion about double combustion contained in the opening remarks on this subject were prompted by the desire to reduce the furnace temperature, and with it the wear and tear of the boiler. Nearly the same object could be attained by re-introducing into the furnace some of the waste gases after they have been cooled down. Thus, assuming that the combustion is perfect, as it ought to be if heated air be used, and that, therefore, the furnace temperature might be 1000 or more degrees hotter than is usual, plus the excess temperature of the heated air—say, 4000 deg. Fah.—then, if we abstract 33 per cent. of the waste gases of 140 deg. Fah., equal to 50 per cent. of the air supply at, say, 400 deg. Fah., and add the two together, the resulting furnace temperature would be 2700 deg. Fah., a temperature which is high enough to ensure complete combustion and yet so low that it would not injure the boiler. This procedure is indicated in the diagram by a diagrammatic fan, which draws waste gases out of the chimney and delivers them into the air duct for the furnace. One slight additional advantage would be that 33 per cent. of the waste heat is saved and the chimney loss, instead of being 3 per cent., would be reduced to 2 per cent., or, remembering that we now have perfect combustion, the chimney loss should be $1\frac{1}{2}$ per cent. Against this there is to be placed either the increased size of the boiler, for the heating surfaces have to be somewhat increased on account of the lower furnace temperature, or the increased expenditure of driving the gases at a high velocity.

Another alternative would be to supply the furnace with an excess of air. Then, however, the chimney loss, assuming 140 deg. Fah., would be increased and the power required for propelling the air would have to be added to.

Oil Burning

Oil burning may enter into the consideration of a boiler design, and it is desirable to have a clear idea as to the

* From Mr. C. E. Stromeyer's Report to the Manchester Steam Users' Association, 1922.

conditions of perfect oil combustion. No matter what the type of the burner, the primary condition which it has to fulfil is to reduce the oil to the minutest particles. This minuteness is limited. The oil particles, as they leave the edges of the burner, do so at a velocity corresponding with the propelling pressure either of the oil itself or of the driving steam or air. A large part of this velocity is of a rotary order, creating centrifugal forces. These are the cause of the disruption of the oil into minute particles. The limit is reached when these forces are balanced by the surface tension of the oil. According to an estimate based on a steam velocity due to a pressure of 70 lb. per square inch, the limiting size of the resulting oil drops would be $^1/_{800}$in., which seems to be a common size under these conditions. With pressure burners higher velocities and, therefore, smaller diameters can be obtained, and if the oil be heated and the surface tension reduced, the diameters would be still less. Whether it is right to go to extremes is not quite clear. The smaller the particles the more quickly will they acquire the velocity of the surrounding air, instead of being shot through it; but if stationary in the air, complete combustion is prevented by the mantle of CO_2, which envelopes the oil nucleus, even if, by now, it should have been converted into vapour. Carbonisation due to the intense heat will take place, and when, finally, the carbonised nucleus emerges, it only does so to find itself in an atmosphere poor in oxygen, and its own carbonised conditions are a bar to its re-ignition and complete combustion.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE HUMAN SIDE.

SIR,—Your correspondent "Timon" has uttered his demand boldly and unequivocally. I feel sure that many of your readers will endorse his request, as much upon the grounds of justice as of expediency. Your editorial footnote is encouraging, but scarcely encouraging enough.

This consistent neglect of the human side is the cardinal sin of omission, not only in THE ENGINEER, but in most of the important technical journals. It may truthfully be said of these periodicals that they have no soul. We read them assiduously enough, but mainly under a sense of duty and without genuine relish. Probably there are a select body of engineering highbrows who can assimilate the technical fare week by week with gusto; but is the mainstay of any journal not the general or average reader? For him, fortunately, there are always the advertisements. I met an engineer in a hotel once who confided that the advertising pages of a certain journal were for him a perennial spring of new and valuable ideas—but I stray from my theme.

The engineering journalist has hitherto, to my mind, cherished a much too limited conception of his mission. He has concentrated on technical data and mechanical achievement to the exclusion of the human mind and hand which produce these things. The quality and quantity of either mental or physical output is determined mainly by the conditions that are dominating the human being. If the horseshoe is not right, the fault is more likely to be in the smith than in the hammer. The human element is, after all, the "big noise" in the sphere of engineering, and until it functions harmoniously the science and practice will always be less than the best.

I have, it will be seen, assumed that the vocation of the journalist is to cater for the profession and industry as a whole, and not for any select body, however important or distinguished. But, says the journalist, we have catered for the human side. Behold how we have pursued and threshed such topics as industrial organisation, psychology and fatigue! But, with all due respect, I say that these have too often been mere shibboleths to bring us into whatever movement is the correct one for the time being. In a good deal of the writing on these subjects there has been visible the attempt to apply to men the same laws and methods that had hitherto been applied to matter and motion. And these writers pretend to be surprised and pained at strikes, lock-outs, ca'canny, to say nothing of the more personal grievances that keep the staff from smiling!

Mr. Nasmyth, inventor of the steam hammer, had an original definition of engineering—"Common sense applied to the use of materials." At present, there is too much time and space devoted to the materials and too little to the common sense and the instrument which produces it. Look what happens when an engineering firm floats a house organ. So keen is the spontaneous demand for "human stuff" that the pendulum swings to the other extreme, and the lighter and human sides are overdone.

In short, my contention is, like "Timon's," that an important engineering journal should devote a fair amount of its space to the *rationale* of what, for want of a better phrase, I shall term the engineering humanities. So long as engineering subsists on an economic basis, human problems will be found side by side with technical problems, and the well-being of the industry will call for the solution of both. Out of the relations between master and man, between man and man, and between firm and customer, questions of difficulty are constantly arising which can only be resolved by an understanding of the human side. In fact, the human difficulty may be as big for some of us as it was found by James Watt when he was pioneering his condensing engine in Cornwall. He wrote to a friend: "The struggles we have had with natural difficulties, and with the ignorance, prejudice and villanies of mankind, have been very great." We do not aspire to transform THE ENGINEER into a sentimental or a comic paper, but would be glad to find some matter in its pages confirming our belief that a kind word and a smile are as potent in engineering as in other departments of life.

Glasgow, December 16th. ALEXANDER MCLEAN.

ERRORS IN GAUGING.

SIR,—It has been with particular interest that I have read Mr. Wickman's letter on "Errors of Gauging" in your issue of the 8th inst. There exists considerable foundation for his allegations of what one might call "ostentatious accuracy or precision"; in fact, I can recall many instances during the past few years where it has been my unfortunate task to persuade engineers that their pride of high precision in their shops has been fictitious. The display of close tolerances on drawings can usually be taken as indicating that the manufacture of the parts represented by such drawings has not received the consideration of an experienced engineer, but rather that the tolerances have been conveyed from some standard table by a draughtsman without any consideration of the practicability of the request he is imposing on the shops. This statement will no doubt raise a very delicate question, one that has been responsible for much controversy in the past and which has erroneously had the title of "Theory *versus* Practice." The standard tables referred to are usually prepared on certain assumed principles. Formulæ are prepared which meet these basic principles as regards clearances, overlaps, tolerances, &c., in relation with the size of the work, the results being plotted in graph form, and the tables compiled accordingly.

Then the "snag" occurs! The academic critic discovers that with the female work on one extreme of the limit and the male work on the opposite extreme, the resulting fit is not an ideal one, and a general controversy commences on the extreme cases. The unfortunate point is that his argument is a very strong one, and usually defeats the more logical argument, viz., that such cases rarely, if ever, occur, and that the whole discussion should centre around work lying on the mean dimensions. The result usually is that the tolerances are reduced accordingly, and the standards automatically become useless. We have a particularly good example of this sequence of events in the case of tolerances for screwed work. The original Engineering Standards Association work on standardisation of screw threads set a precision standard which was totally unsuitable for repetition work, and it was against great opposition by the academic arguments that the tolerances were increased approximately threefold in their revised report, with the result that to-day we have standard tolerances for screw work which can be complied with without any drop in the class of product.

It is admitted that with screw threads, the logical argument is a much stronger one than with that of cylindrical work, as there are five elements, all of which can vary at the same time, and, consequently, the chances of extreme cases meeting extreme cases are very remote. Nevertheless, the same argument does apply to cylindrical work, although to a lesser degree, and it should be borne in mind when tolerances or limits are determined.

I am firmly convinced that the basic idea of any limit setting, whether it be in the form of safeguarding dimensional variation or in the preparation of a material specification, the unit of permissible variation should always be determined by a study of "what has already been achieved," and not an expression in the form of a "pious hope." No one would dream of asking for a phosphorus content of not exceeding .01 per cent. in a steel specification, or, better still, an ultimate strength of 35 tons per square inch in a timber specification. Surely the same argument applies.

The old practice of one set of tolerances on drawings and another interpretation of them in the shops is causing endless confusion in the modern engineering circles. The development of inspection, whether on the part of the producer for his own benefit, or on behalf of the buyer of the product, is considerably hampered by such a state of affairs.

London, N. 21, December 16th. PERCY BISHOP.

SIR,—I have read with a great deal of interest the letter by Mr. Wickman *re* "Errors in Gauging." Should the points he has raised be correct, it is a striking indictment against the English practice of the limit system. As one who has seen how the American practice works, may I offer a few remarks?

(1) I suggest that the first care should be to get the correct mean dimensions for the parts of a product on the drawing—that is, the dimension which is the ideal to be aimed at in production.

(2) That the limit to each dimension should be above and below, or plus and minus, to each dimension, and to estimate this limit the following should be taken into account:—(*a*) The class of machines upon which the work will have to be done and the unavoidable errors which these machines will reproduce, owing to wear, age, bad cleaning and wear of tools in operation; (*b*) tolerance or provision for error in making the workshop gauges; (*c*) tolerance or provision for error in making the master gauges for inspection; (*d*) provision for fits, if they cannot be covered by (*a*), (*b*), (*c*).

From the above it will be seen that the limit on the drawing must include errors included in (*a*), (*b*) and (*c*), and also possibly (*d*), so that when the job is finished the dimensions will never be outside the permissible limit, either plus or minus, on the drawing.

It is admitted that this is no easy work, and for fine products where small limits are essential it is only practicable where large quantities have to be produced. The limits on the drawing for any product should be as large as is consistent with good functioning after all the above have been taken into account, although there is the obvious disadvantage that where extremes are taken in any one way on the drawing, the result may represent several months' wear of the article after it has left the factory.

For really high-class interchangeable work the only way to attain good results is to make a sample product and use the components, after experiment, to fix the limits on the drawing. The whole trouble seems to be that drawing limits are fixed without taking into account the factors mentioned in (*a*), (*b*), (*c*) and (*d*).

I agree with Mr. Wickman that we have a too highly exalted opinion theoretically of our fine tolerances, so high, indeed, that they are not worked to practically in actual practice. I plead for more true reality in this matter, so that nothing shall be put on the drawing that cannot be fairly and truly worked to. I think if this were the case, considerable improvement would be shown in the care of the equipment in many so-called high-class up-to-date workshops.

Sheffield, December 16th. ARTHUR BRAMWELL.

ELECTRIC LOCOMOTIVES.

SIR,—It is a familiar trait in a "salesman" to accuse a locomotive superintendent of lack of open-mindedness if the latter does not see eye to eye in the matter of asking railway directors to spend money on schemes, the recommendation of which he is not dead sure of being to their advantage. Study and experience of railway history and development shows clearly the evolution of and necessity for locomotive superintendents—one prefers the good old name to that of chief mechanical engineer—to whom the fact of so much having been left by wisely trusting boards enabled our railways to stand up to their work during recent years of intense unforeseen stress, and by whom the hoary, interested gibe of "unprofitable railway building of locomotives" has always been considered to be too puerile for notice.

Whatever might happen concerning the superintending *personnel* of our railways under electric working, the introduction of intricate self-propelled internal combustion arrangements would involve stronger arguments still for the building as well as the running of such machines being absolutely in the hands of the company's principal servant, however advisable their use. No, Sir, with due respect to your correspondent on this subject in your issue for last week, it is to the blunt directness and honesty of our trained locomotive superintendents that the stability of our railway systems has been due.

It is now the fashion to deride these gentlemen, seeking to curtail their authority, but a casual survey of some of our main lines indicates that their directors, before considering new methods of haulage, would be better advised again to grant full authority to their locomotive superintendents, thus enabling them to bring out-station buildings and steam sheds into position for obtaining the best from present-day steam power for coping with present-day traffic—a point, Sir, you, Sir, so trenchantly noted in one of your welcome and all-too-few leaders on the subject about this time last year.

December 18th. CECIL G. HOWSIN.

SIR,—Mr. Durtnall's letter is quite as open to criticism as the points he criticises. He first condemns the railway engineers for their correct attitude towards a paper, which, brilliant as it is in statistics and information about the past and present, affords no assistance for the future of railway engineering. He then eulogises the electrical engineers for trying to continue the errors of the past by the aid of electric power instead of steam. He then offers a third abomination in the form of a combustion motor locomotive.

The fact that the locomotive is as much out of place in modern railway practice as the horse in our streets is entirely disregarded. Let me quote three remarks that have already appeared in your columns, but which, although of paramount importance, have been entirely disregarded.

Professor Cramp: "It is assumed that matters will be the same under electrification as with steam. This is to begin absolutely at the wrong end. It has been the same with road transport." (N.B.—We may say the same of electric supply.)

Mr. Geo. Wilkinson: "It will be found cheaper in many cases [he might safely have said most] to carry coal to the distributing centre than to carry current."

Mr. P. V. Hunter: "After all, it is not so much the supply stations that we have to link up as the distributing mains."

The first tells us that we must study all innovations from the point of view that will obtain under the new conditions that will then prevail. The second discriminates between bulk generation and improved distribution. The third tells us the truth about bulk supply. If the first is taken as a guide, it will prepare the way for a sound commercial scheme for electric supply, railway electrification and road transport. There is certainly no "problem" in it, except to slavish conservatism and prejudice.

A locomotive is not a vehicle but a mechanical means of drawing vehicles. It serves its purpose because under old conditions it was practically impossible to attach a steam engine to each carriage. Under the new conditions, it is easy and better to attach an electric motor to each carriage or truck and eliminate the heavy, unnecessary locomotive. It is here that railway engineers are deserving of the strongest censure. To remove the ponderous locomotive and distribute its weight along the train is one of the soundest engineering jobs imaginable, and should have been done years ago. The real obstacle has been the neglect of the electrical profession to push electric supply as they should have done.

Forty years have passed since the Act of 1882 afforded any and every electrical engineer the opportunity to build up a sound business and give a supply to everybody within his area. Time and thought have been lavishly wasted in trying to evolve a charging system that would admit a poor supply to be run on profit-earning lines, instead of boldly facing the matter and offering a charge that would induce enough custom to popularise electricity.

Again, with road transport. The many blue-books that have been issued since the Royal Commission on London Traffic sat in 1903–4–5, if considered from the conditions that would prevail with horses and trams eliminated and a regular procession of mechanically driven vehicles substituted, are not worth the paper they are printed on. The statements would no longer be true and the arguments would have no application.

The cost of suitable roads for mechanical traffic would be more than covered by the actual savings in "total working costs," as given by the principal motor vehicle owners. In addition, we should have improved sanitation, absence of congestion, easy travelling during the rush hours, freedom from obstructive repairs and reduced costs of same, and, above all, a cheap supply of electric power in every town and hamlet throughout the country. All by a strictly common-sense use of existing ways and means.

London, December 20th. ERNEST G. PINK.

A CORROSION PUZZLE.

SIR,—The driving pulley of a heavy "Herbert" turret lathe fits on a key sunk into the shaft, and the fit of the pulley on the shaft itself is a sliding one. The pulley is clamped up endwise against a shoulder on the shaft through a ball bearing and distance washer, the nut being of the helicoid type.

What happens in practice is that after a short period of use the pulley becomes rusted on to the shaft, so that it cannot be removed without breaking it, this having happened in a number of instances. Various things have been tried to overcome this difficulty. The parts have been assembled with a liberal supply of oil, of grease, of tallow, of white lead and tallow, and so forth, but without the slightest effect upon the rusting, which takes place in spite of these lubricants being used.

I understand that ball bearing manufacturers have had similar troubles with ball bearings fitted on to shafting, and that they attribute the rusting to some vibratory action which appears to be little understood.

Possibly some of your readers might be interested in solving this puzzle, which has occurred on more than one design of machine, and is not peculiar to particular proportions.

Coventry, December 16th. P. V. VERNON.

[This curious effect, which is frequently known as dry corrosion or mechanical rusting, is not an uncommon experience, and received a good deal of attention in our columns some years ago—see THE ENGINEER, November 24th, 1911; letters, December 1st, 8th, 22nd, 1911. A complete explanation has not yet been advanced, but the most probable appears to be that minute particles of iron are flaked off by rubbing or impact, and are instantly oxidised. The trouble would probably be stopped if the pulley were made an easy *press* fit on the shaft. —ED. THE E.]

A "Back Pressure" Process Steam Problem.

By G. JAMES WELLS, M.I. Mech. E., A.M. Inst. C.E., Wh.Sc.

IT frequently occurs that a certain weight of low-pressure steam is required for heating, or some other process work, when the boilers are supplying high-pressure with or without superheat for the power station. This low-pressure steam may be obtained by the use of a reducing valve, but the more usual way is to install a steam dynamo set, arranged to give the required supply of low-pressure steam at the exhaust outlet. The problem then arises as to the probable output of electrical energy and its cost in steam per unit of output, &c.; and the object of this short note is to show how, by means of two diagrams, a solution may be readily obtained by measuring the length of two lines on one of these diagrams and noting the point of intersection on a scale in the second diagram. This simple method of solution, it is thought, may be of interest to engineers whose practice includes such problems.

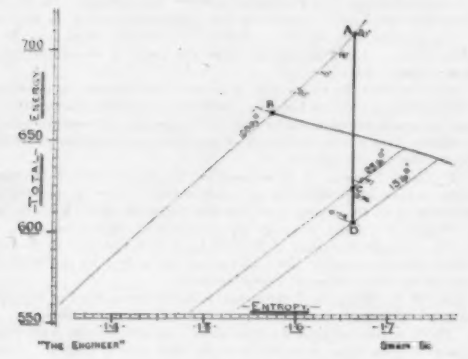


FIG. 1

Each diagram gives the results in terms of a pound of steam as the unit, and the heat units may be either in terms of the B.Th.U. or the C.H.U., as preferred. The difference between these units is solely in the thermometer employed.

In the Mollier chart the properties of steam employed for plotting the "state" or condition of steam are: total heat per pound as the vertical co-ordinate, and the "entropy," reckoned from 0 deg. Cent. or 32 deg. Fah. The lines drawn upon it usually show (i.) constant pressure, and (ii.) quality, *i.e.*, amount of superheat or amount of moisture present. Some of these charts give the quantities in terms of Centigrade, others in terms of the Fahrenheit scale of temperatures. Now, the result is, that if a constant entropy line be drawn on this chart, from the given initial state of the steam to the final state, then its length is the "heat drop" or area of the Rankine cycle. Hence this Mollier chart will at once determine the amount of heat available for power and for process work per pound of steam supplied.

Examples.—Suppose that in a factory 4500 lb. of steam are required for a process per hour, and that the pressure head necessary to drive it to the several points required is

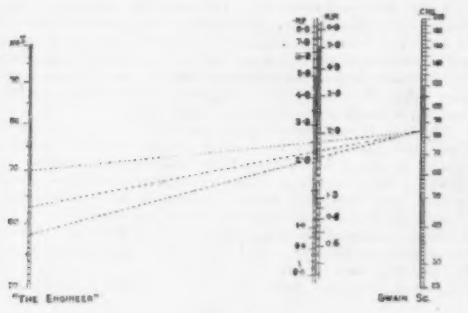


FIG. 2

10 lb. per square inch. The factory boilers supply steam at 135 lb. per square inch gauge pressure, superheated 80 deg. Cent.

Place a piece of tracing paper over the Mollier chart and mark the intersection A of the (135 + 15) lb. per square inch pressure line and the temperature line 263 deg. Cent., which is 80 deg. above the saturation temperature B; this is the initial state point of the steam. Drop a line perpendicularly downwards (*i.e.*, a line of constant entropy) until it cuts the engine back-pressure line (10 + 15) at C, and continue it downwards until it cuts the line of atmospheric pressure at D. The length A C = the heat drop of 84 C.H.U., and C D an additional drop of 20 C.H.U.; the dryness fractions at C and D are 96.6 per cent. and 94 per cent. respectively. Fig. 1 shows the tracing complete, which may be finally gummed to the estimate sheet, thus preserving the whole for future reference.

Since the steam consumption is 4500/60 or 75 lb. per minute, the total heat available for the process work is at once obtained and is equal to the heat drop C D plus that given up due to liquefaction and cooling to the final temperature.

The remainder of the problem is solved by means of the alignment diagram shown in Fig. 2, which consists of three scales logarithmically divided, the right-hand line being graduated to represent the area of the Rankine cycle; the left-hand line gives varying percentages of efficiency, and the intermediate scale is graduated to read horse-power and kilowatts as required. A third scale of net heat units may be added, but is of only secondary interest and has been omitted.

Assuming a compound, quick revolution, short-stroke engine, the diagram factor would be about 0.7; then stretch a thread across Fig. 2 so that it crosses the L.H. scale at 0.7 and the right-hand scale at 84 (the heat drop A C, Fig. 1), then it will cross the intermediate scale in the H.P. scale at 2.5; hence the I.H.P. is 2.5 per pound of steam per minute, i.e., $75 \times 2.5 = 187.5$ total I.H.P., and the probable steam consumption will be $= \frac{60}{2.5} = 24$ lb. per I.H.P. hour.

If the mechanical efficiency of the engine is 90 per cent., then the combined efficiency is $= 0.7 \times 0.9 = 0.63$. Now stretch the string from 0.63 to 84 and it then cuts the intermediate line at 2.25 B.H.P., so that the B.H.P. of the engine is $= 75 \times 2.25 = 168.8$ B.H.P. and the steam consumption will $= \frac{60}{2.25} = 26.7$ lb. per B.H.P. per hour.

Again, if the efficiency of the generator is 92½ per cent., then the overall efficiency $= 0.7 \times 0.9 \times 0.925 = 0.582$ per cent. Stretching the string between 0.582 per cent. and 84 C.H.U., the readings are 2.08 electrical horse-power or 1.55 kilowatts, so that the output of the generator will be $75 \times 1.55 = 116$ kilowatts and the steam consumption per kilowatt-hour $= \frac{60}{1.55} = 38.7$ lb.

In Fig. 2 the dotted lines represent the threads in the several positions referred to above.

As a test of the accuracy of the above results the several quantities have been calculated by means of some steam tables and the slide rule.

		As above.
Heat drop A C calculated ..	84.45 C.H.U. ..	84.0 C.H.U.
Heat drop C D calculated ..	19.7 C.H.U. ..	20.0 C.H.U.
Dryness fraction at point C ..	0.961 ..	0.966
Dryness fraction at point D ..	0.935 ..	0.94
Calculated I.H.P.	187.7 ..	187.5
Calculated B.H.P.	168.95 ..	168.8
Calculated K.W.	116.58 ..	116
Steam per I.H.P. hour, cal'd.	23.97 lb. ..	24 lb.
Steam per B.H.P. hour, cal'd.	26.62 lb. ..	26.7 lb.
Steam per K.W. per hour, cal'd.	38.59 lb. ..	38.7 lb.

It would be easy to multiply examples, but the one given appears to illustrate the possibilities of the speed with which a number of propositions could be accurately examined before finally fixing the details of a scheme. The possibilities of the Mollier chart in the steam engineer's designing room does not seem to be fully realised in practice.

1500-Volt Rotary Converters.

WHILST some engineers seem to consider that the conversion of 50-cycle three-phase current into 1500-volt direct current involves the use of two rotary converters connected in series, others maintain that only one machine is necessary, and on the Continent quite a number of 50-cycle 1500-volt machines appear to be under construction. In an article in a recent issue of the *Brown Boveri Review*, Mr. N. Widmer explains that the results of tests made on the first 1650-volt 50-cycle machine demonstrated quite clearly that it was possible to build such machines for use in the sub-stations of main line railways. The maximum pressure for which a pure direct-current machine or a rotary converter can be built, the author goes on to explain, depends upon the number of commutator segments that it is possible to use between brushes of different polarity. The more the distance between two adjacent brushes of different polarity can be increased, the higher will be the permissible maximum pressure. The distance between the brushes can be expressed as

$$\frac{\text{Commutator circumferential velocity}}{\text{Twice the frequency.}}$$

The distance between the brushes in the case of a 25-cycle rotary converter can be twice as great as that on a 50-cycle machine working with the same commutator circumferential velocity. In the case of a direct-current machine the frequency can be chosen to suit the requirements, but the rotary converter must work at the same frequency as that of the alternating-current system. Thus in the case of the rotary converter the maximum pressure at a given frequency is dependent upon the commutator circumferential velocity, the subdivision of the commutator segments and the average difference of pressure between the segments.

To solve the problem of building high-pressure rotary converters it has been necessary to break away from the old and accepted traditions. Seven high-pressure rotary converters have been ordered from Brown, Boveri and Co. by the Midi Railway of France, and some of them have already been delivered. The machines are designed to operate in parallel with power rectifiers installed in neighbouring sub-stations and to be capable of returning the energy produced by regenerative braking to the alternating-current system. The continuous output of each machine is 750 kilowatts, but 1125 kilowatts can be delivered for two hours, following a continuous full load output, whilst 2250 kilowatts can be developed for five minutes following a continuous full load. The no-load pressure is 1650 volts, the speed 750 revolutions per minute, and the frequency 50 cycles per second.

It will be perceived that the requirements as regards overload are very stringent. Other conditions laid down by the purchasers are also more exacting than many that have been met with in the past. For instance, the converters must be able to withstand five consecutive direct short circuits at intervals of 60 seconds. To meet the overload conditions the parts which are most subject to heating are cooled by a well-thought-out ventilating system, whilst in order to ensure satisfactory commutation at times of heavy overloads the makers' patented commutating poles are fitted. Special attention has also been paid to protecting the machines against the effects of short circuits, which are inseparable from railway service. By the correct dimensioning and proper spacing of all the current-carrying parts it is said to be possible for the machines to deal satisfactorily with heavy short circuits, even in the event of the direct-current protective apparatus failing to work.

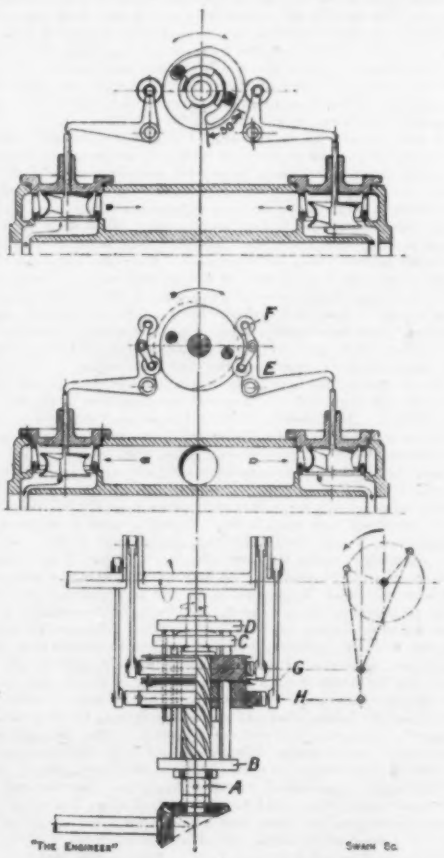
Notwithstanding the high circumferential velocities that are necessary with converters for such high pressures, the machines are said to run very smoothly and without producing a disagreeable noise. As all the windings are insulated in respect to the frame for the full working pressure it is unnecessary to insulate the machines from earth. The field current is generated by an overhung exciter which enables the correct polarity always to be obtained at synchronism without using any auxiliary apparatus. By means of a starting motor with a flexible coupling the machines may be started up on the alternating-current side and the synchronising may either be done with an ordinary synchroscope or automatically by connecting a synchronising choke coil between the slip rings and the secondary terminals of the transformers, the latter scheme being particularly suitable for automatic sub-stations equipped with large converters.

The first Brown Boveri rotary converter of this description was thoroughly tested in the Baden works under all the conditions occurring in traction service as far as they could be imitated with the means available on the test bed, and all the tests gave satisfactory results. When starting with the synchronising choke coil it was found possible to start up and parallel the machine in about 70 seconds. Direct starting tests with reduced pressure and with the rotary converter starting as an asynchronous motor also gave very favourable results. Efficiency tests proved extremely satisfactory. Part of the continuous and overhead tests, which were combined with the measurements of the temperature rise, were carried out at pressures up to 1800 volts.

For the recuperation tests the rotary converter was connected on the direct-current side in parallel with two direct-current machines of corresponding pressure, and the load was varied by changing the excitation of the latter, and no other auxiliary plant was necessary. During the short circuit tests, made with the assistance of a Brown Boveri quick-acting direct-current switch, not only were the prescribed five direct short circuits carried out without the slightest difficulty, but the machine easily withstood more than twenty short circuits at intervals of about 60 seconds without the commutator or brush gear requiring the slightest attention. All the short circuit tests were made at full pressure both when the converter was on load and when it was running light, and after the interruption of the short circuit the machine continued to run normally in each case. In all, over 150 short circuits were applied to the machine without detrimental results, and in no case was it found necessary to overhaul any of the parts.

The Caprotti Locomotive Valve Gear.

THE valve gear which we are about to describe and which has been tested with satisfactory results on a goods locomotive on the Italian State Railways, has been designed by Signor Caprotti with the dual object of removing those



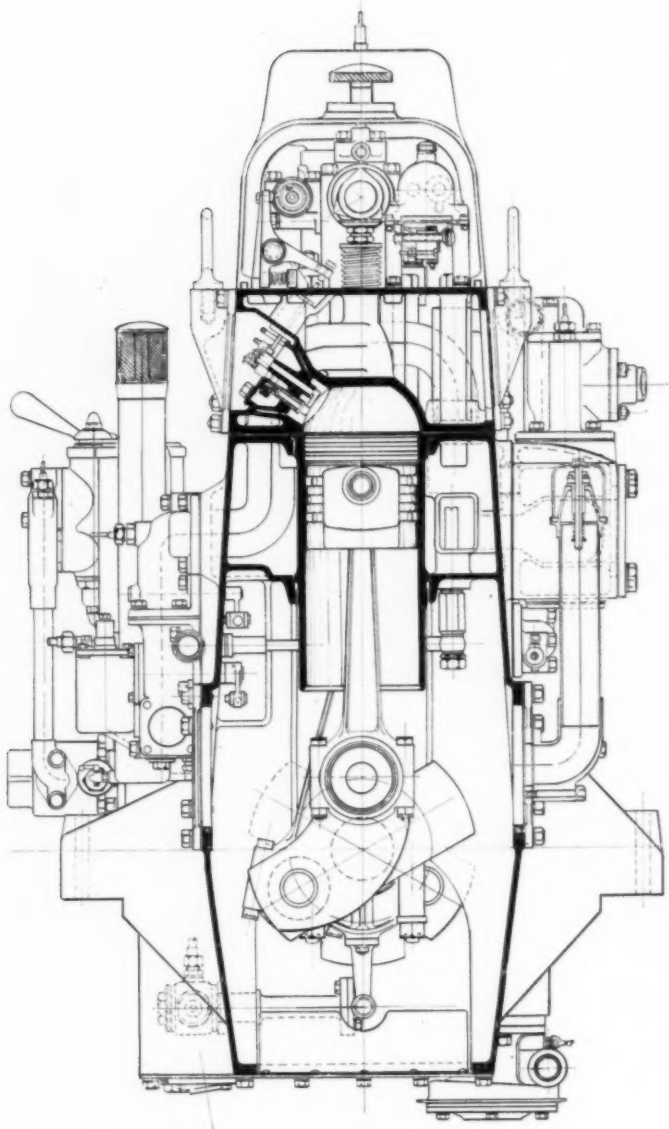
CAPROTTI DROP VALVE GEAR

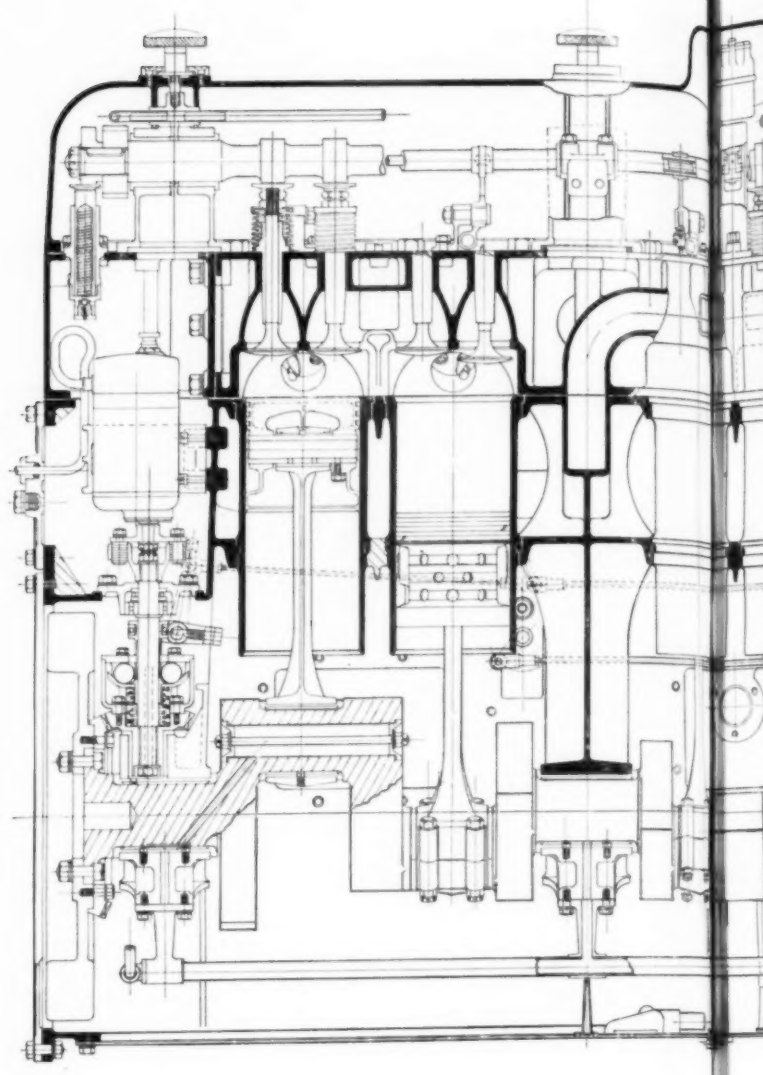
variations in distribution that occur with link and radial motions and of replacing slide or piston valves with drop valves.

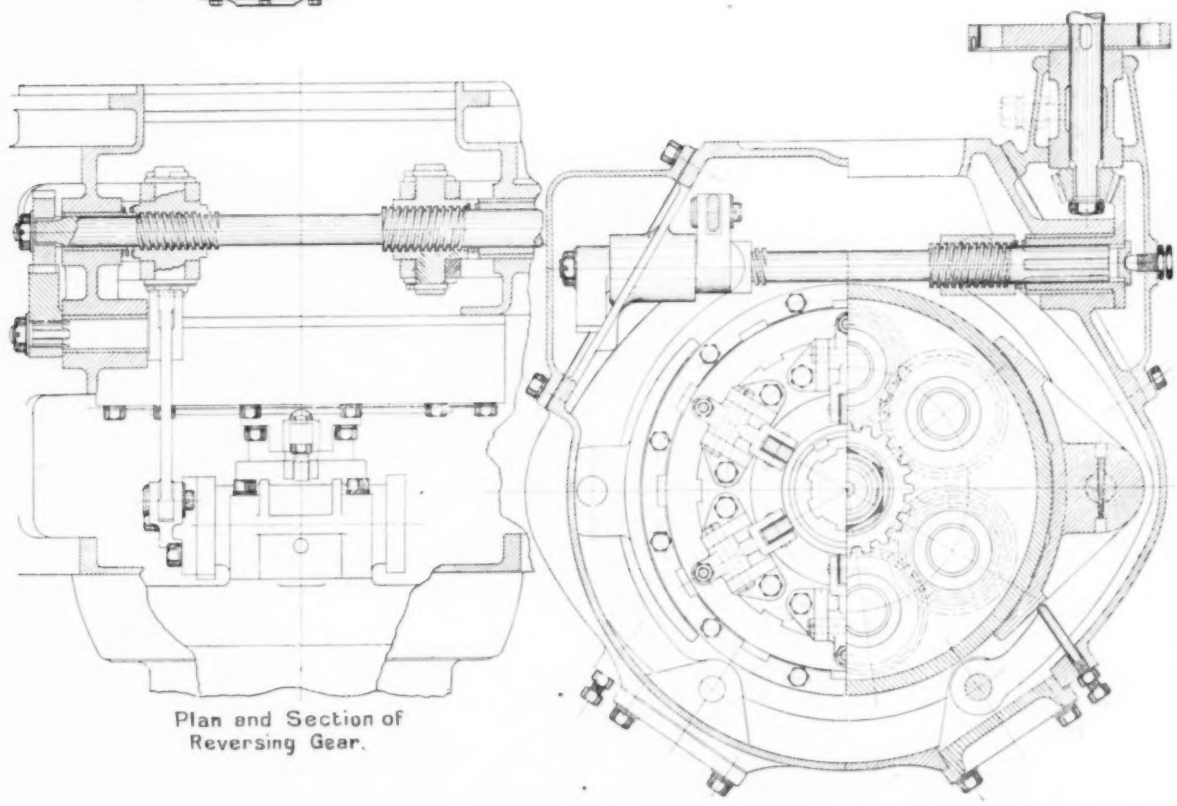
In the figure the upper view shows the exhaust valves and their mechanism, the centre view shows the admission valves and their mechanism, and the lower view the distributing mechanism itself. All four valves are placed upon the top of the cylinder, and they are operated by a series of three cams carried on a shaft A which is driven at a constant speed from the crank shaft through two pairs of mitre wheels. For the control of the exhaust a single cam

THE NEW "D.E." TYP L

THE ROYAL NATIONAL LIFEBOAT INSTITUTION, DESIGNERS; THE W URN



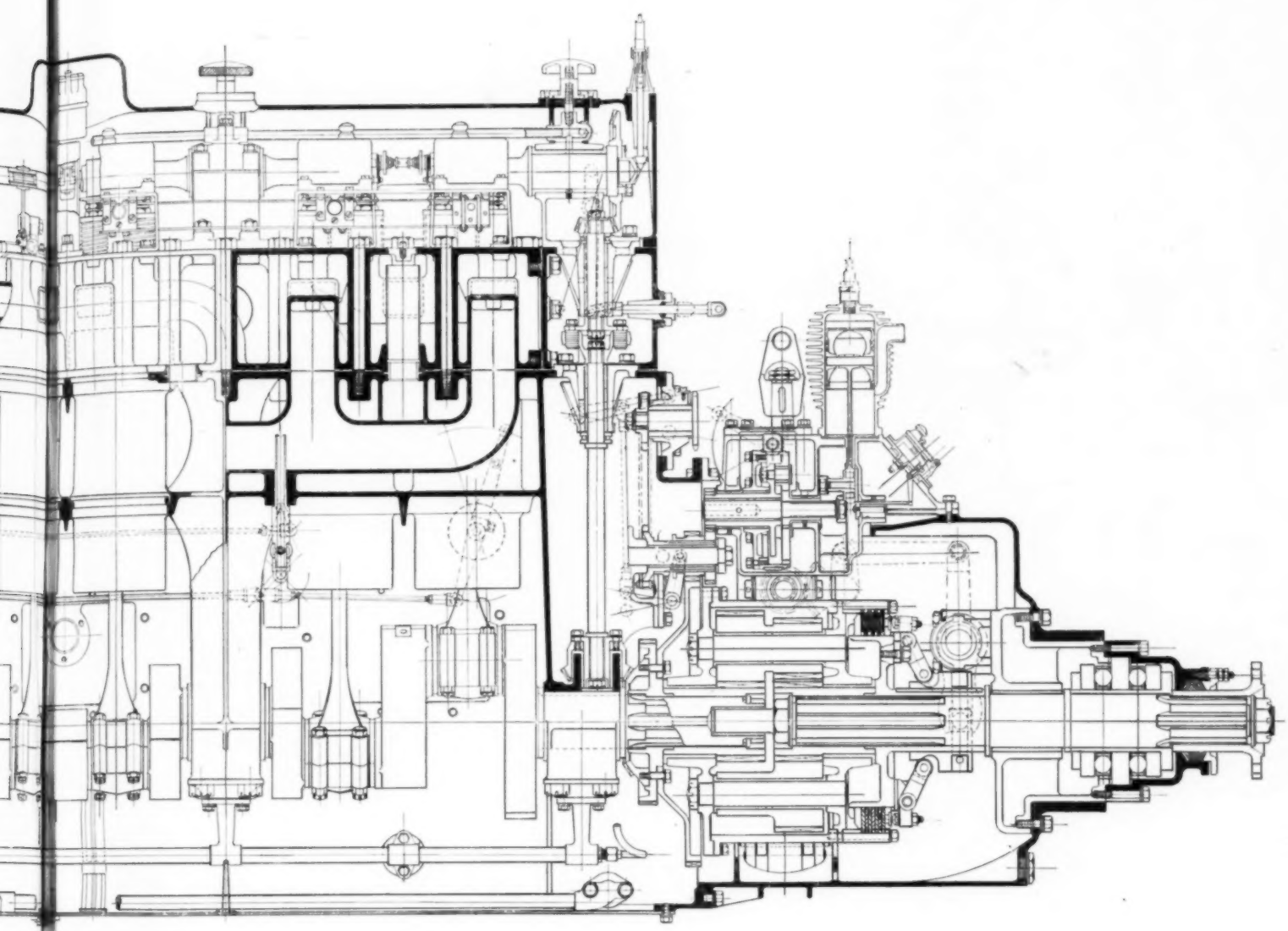


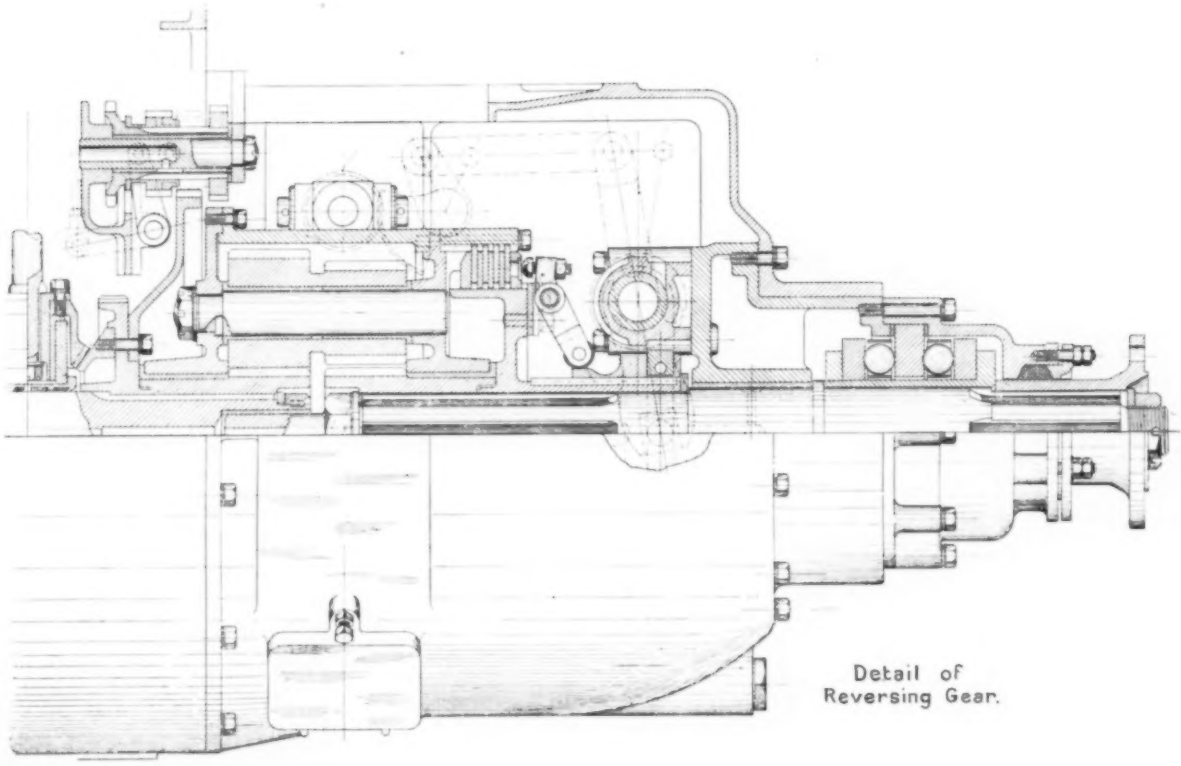


Plan and Section of
Reversing Gear.

TYP LIFEBOAT ENGINE

THE W[illegible]URN ENGINEERING COMPANY LIMITED, ELSTEAD, SURREY, BUILDERS





Detail of
Reversing Gear.

Swain Sc.

B is employed; it acts upon two bell-crank levers, the free extremities of which press the valves open. (None of the springs which hold the valves to their seats are shown.) A simplicity of movement which is adequate for exhaust would not, of course, meet the requirements of variable admission, and a more complex arrangement is necessitated. It takes the form of two cams C and D lying side by side. Upon one of these cams the roller E presses, whilst the roller F presses upon the other; but the two rollers are carried on a single floating lever hinged to a bell-crank lever. It will be obvious that if an excrescence on one cam corresponds precisely with a depression in the other the floating lever will rock about its centre and nothing more; but if the excrescence does not correspond with a depression then the floating lever will be moved bodily and the bell-crank lever will open the valve. Hence it will be seen that by suitable relative and positive movements of the two cams the period of admission may be varied, whilst the angle of advance and amount of valve opening may be maintained constant.

The means employed for changing the position of the cams is seen in the bottom view in the figure. Here it will be observed that the shaft A is provided with a four-threaded screw of steep pitch. On this screw are mounted two plates G and H, capable of being moved endways by the cranks and links shown. The plates are coupled to their respective cams by rods, and since any movement of the plates along the screw must cause them to rotate relatively to the screw, it is clear that the cams will also be rotated; in other words, that they will change their phase relatively to the crank shaft. It will be noticed that the cams actually take a very simple form.

The gear is interesting, not only because it employs drop valves, but because it shows a radical departure from locomotive practice in the absence of all the customary linkage. The mechanism can be entirely enclosed, which is a strong point in its favour.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Indications of Trade Improvement.

EVIDENCE of the improvement in the iron and steel trade is afforded by the official returns of production and the Board of Trade figures relating to exports, published this week. The production of pig iron for the country generally during the month of November was 493,900 tons, which is much the best since the coal strike. It represents, however, only 57 per cent. of the average monthly production of 1913. Steel is making much greater progress, with an output of 600,800 tons for November, only 32,000 tons below the 1913 average, and about twice the output of this time last year. The same progress is shown by the Board of Trade returns, the increase being, in the opinion of Staffordshire iron and steel masters, somewhat remarkable in comparison with November of last year, under the heads of pig iron, bars, rods, angles, &c., steel girders, plates and tin-plate. Plates and sheets, for example, increased from 5601 to 11,433 tons, and bars, rods, &c., from 14,740 to 31,205 tons. The exports of forge and foundry iron during the month were 78,641 tons, as compared with 5218 a year ago. The large business with America was, of course, mainly accountable for this. This year's monthly average of 268,700 tons of iron and steel exports is considered very satisfactory, being only a little short of the figures for 1920, which stood at 270,000 tons.

Raw Steel Values.

Values of unfinished steel continue on the up grade, and this week the minimum price for native billets would appear to be £7 7s. 6d., or 2s. 6d. more than last week's prices. Many quotations are much higher, £7 10s. and even £7 15s. being asked by some makers. There are buyers who, viewing with alarm the recent rise in price, have been rushing their orders on the market, despite the fact that this week business has, generally speaking, been quiet on account of the approaching Christmas holidays. Continental billets, in spite of the increase in native prices, are not competitive. The Belgian steel works have taken on as much business as they can manage for some time, and the English consumers are now looking to the home works to supply their needs. Finished steel is decidedly firmer, with an upward tendency. There is a general impression on Birmingham 'Change that the Welsh steel firms will make an advance in the standard bar prices early in the New Year, if not before. Small bars and gas strip are firmer, the re-roller having been obliged to make an advance, following the rise in billet values. Small steel bars, which have long been unprofitable at £8 15s., were quoted on the Birmingham iron market to-day—Thursday—up to £9 5s., but that figure is in excess of buyers' ideas. Some makers, however, claim to have obtained £9. Bedstead angles can still be bought for £8 15s., which is regarded as a low price, and made possible only by the keen rivalry of one or two Staffordshire firms. Firms outside the district are asking £9 5s. to £9 10s., but they find it difficult to make sales in competition with the lower rates.

More Midland Mills at Work.

Makers of finished iron in the Midlands and Staffordshire are looking on the bright side of things, and the portents to-day are considered by them to be much more favourable than for many months past. They are hoping that the slight expansion of demand already apparent will assume larger proportions in the New Year. There are more mills in employment in this area at the moment than for some time past. Warehousemen have come forward with orders, having decided that the time has come to renew their stocks. For the present unmarked bars continue at about £10 10s. to £10 15s., with best iron unchanged at £13 10s. Bar iron for the nut and bolt industry shows slightly more strength, and sellers are cautious about booking forward business. They prefer to take orders for, say, 250 tons at the present price of £9 15s. for delivery in January, rather than 500 tons for delivery later, by which time they expect values will appreciate. Nor are makers open to be squeezed as they have been recently, by people with business to place, and the signs are that the deflation process has reached an end, the more so that the 2½ per cent. advance in wages has now taken effect. Deliveries are being made by Belgian producers against orders placed a little while ago. There is not much inclination to renew business in this quarter on more than a limited scale, consumers being dubious as to the chances of getting contracts punctually fulfilled. It is known that most of the near date output of Belgium has been sold. The Staffordshire district will benefit in many ways from the orders for battleships lately placed, and the chain trade is already showing more signs of animation. Makers of galvanised sheets are meeting with numerous inquiries, but actual business is rather quieter, though most of the bigger firms have their output earmarked for some months. It is again possible to place orders with the smaller firms at £17 5s. for 24 gauge corrugated sheets f.o.b.

Pig Iron Prices.

Makers of pig iron in the Midlands, while they are doing rather more business, have secured only very trifling price increases, practically negligible as regards profit making. No quotable change has been made, but individual producers are asking more for particular brands. Demand is no doubt better, and in Derbyshire has been aided by the placing of American orders, in spite of the handicap of railway rates. There is a better call for foundry iron, although this has hardly reached the normal amount. As the engineering trade has shown some improvement of late, it is hoped that the volume of business will increase. There are still too many idle furnaces in the Staffordshire and Worcestershire area to justify much optimism. Prices are cut too finely to induce the relighting of furnaces, and though it is reported that Alfred Hickman, Limited, intends in the near future to blow in another of its blast-furnaces at Spring Vale, Bilston, nothing more will be done in this direction until the New Year. It is understood that one small Black Country furnace which has been making high grade pig is at a standstill. On the other hand, there are cases in which idle furnaces would probably be restarted as soon as the Christmas holidays are over if the owners could see a prospect of getting continuous supplies of coke at a reasonable price. From 21s. to 22s. 6d. is being asked for coke at ovens. There is no indication that the stringency is being relieved.

Engineering.

There is a considerable hardening in the construction branch of the engineering industry, and an expansion of orders of rather a more profitable character. Construction engineers are busy on small jobs, and there is a good deal of business pending for bridge work and on Indian account. A fair amount of work is being executed for overseas, India and South Africa providing some fruitful orders. The pumping machinery section of the engineering trade maintains a steady moderate tone. There are a few more orders here and there, and the inquiries being received would seem to indicate a healthier period not far ahead, there being an increasing demand for quotations.

The Edge Tool Trade.

The edge tool industry in this area has had several spasmodic rushes of business during the past few months, and, though placid at this moment, it is looking forward to an improvement early next year, when it is believed that trade will be much stimulated. The South American markets have been the brightest spot in the export business of recent date, but there has also been a distinct movement in the East, which has been practically dead for many months. Recent advices from the Straits indicate that trade is reviving there. Manufacturers here are inclined to the opinion that an improvement can be looked for, first because prices and costs are down to the bottom, giving stability in that direction; and, secondly, because buying is becoming necessary after so much holding back of orders.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Outlook.

As we approach near to the Christmas holidays the amount of business in iron, steel and metals naturally lessens, but of this very little notice is taken, and it has no effect upon the more optimistic feeling which pervades the market. One would like to have some assurance that this feeling is not based solely upon Government promises that the unemployment problem is to be tackled energetically during the recess, or even that it depends upon the fact that the contracts for two capital warships have been placed. Building of warships is not a sound foundation for a revival of the iron and steel industries, nor is any consumption which is assisted by Government money. Hence there is room for some doubt as to the expected revival in the iron, steel and metal trades next year. Nevertheless it is some comfort to have a more cheerful feeling in the markets and more inquiry for forward delivery.

Metals.

The increase of strength in the standard copper market may perhaps be taken as an indication of improved trade, although copper prices—that is, for standard and refined ingots—have been so low that a moderate advance might occur without anything startling in the way of increased consumption. With regard to the prices of refined copper, it is noticeable that the rather extraordinary rise in sterling has not depressed the price of American copper, so that one may perhaps assume that there has been a slow improvement in conditions of trade which has counteracted the effect of the fall of the dollar as computed in our currency. There seems to be a belief that sterling will advance still further with the opening of the New Year and approach very near to a par of exchange, which would mean that our paper currency was worth its nominal value in gold. If so, we can scarcely expect to see any appreciable rise in refined copper, although business may gradually improve. In the American market sentiment seems to be more favourable, and this feeling has been increased by the arrangement known as the "Chili-Anaconda merger." This will, of course, strengthen the position of American copper producers; but it does not follow that they will use this strength to put up the prices, and indeed in the present state of trade that would probably be a foolish policy. The demand in Manchester for copper and its alloys is not much better than it was; but, of course, the time of year is against any show of improvement. Engineers are not buying very freely, but it is hoped that buying will increase in the New Year. There is certainly a disposition on the part of dealers to give more money for scrap metals, and this is a sure indication that they have less trouble in selling. Roughly speaking, about £2 per ton more is being paid in Manchester for old gun-metal and heavy yellow brass scrap. The latter, however, is still selling at less than the price of spelter, a position which is probably unprecedented in the history of the metal trade. The official prices quoted for manufactured copper and brass, sheets, tubes, &c., have not yet been altered. Tin has been a fluctuating market and is evidently in a very sensitive condition. It responds far too rapidly to small influences and is exceedingly difficult to follow. The price has been over £180 and again below £176 without any appreciable cause. There is apparently no change in the situation so far as consumption is concerned, and the business going on has been mainly of a professional character. Lead has been comparatively steady, but there are as yet no signs in the market of any serious fall. Spelter is quiet and keeps between about £37 10s. and £39 10s. per ton. The price must be considered unduly high in comparison with the other metal prices.

Pig Iron.

The market here for foundry iron remains rather quiet and, of course, the amount of actual business passing this week is not great. There is some buying for forward delivery, and sellers are still prepared to take orders well into the New Year at 90s. per ton delivered in Manchester. Apparently, therefore, there is not any great expectation of a rise in foundry iron prices up to March next, and indeed one cannot see how any advance can go very far until all the blast-furnaces are occupied. Any improvement in consumption must go, as before, to bring about a larger output. This movement has really been going on all through the year, because nearly twice as many furnaces are working now as was the case in January last, and yet there is no accumulation of iron in any of our centres of trade. The American demand, of course, cleared accumulations in Scotland and Cleveland, but it made very little difference to the Midlands, and this is what concerns the Manchester market. The demand here for Scotch iron remains only moderate, but in this case the price is still far too high for the ordinary ironfounder, although it is much lower than it was two months ago.

Steel.

There is a very optimistic feeling with regard to finished steel at the moment, and it is possible that this will lead to rather better prices in the New Year, although the movement cannot go very far for the same reason which keeps pig iron down. Sectional steel and plates are, however, in rather a different position, because they have long been selling at an actual loss on the cost of production. Reports from elsewhere suggest that buyers of finished material find great difficulty in placing orders with the continental makers, and this may have a favourable effect on British steel, although it does not directly affect the Manchester trade.

Scrap.

There is certainly an improved feeling in the market for scrap of all kinds. Steel scrap and wrought scrap are both firmer, and the dealers are now trying to get rather better prices for cast scrap from the ironfounders of this district. One hears that some rather optimistic sellers are endeavouring to obtain 85s. per ton for good broken machinery scrap. Of course, the price is still low compared with pig iron.

Welfare Activities in Hollinwood.

An improvement in its women employees' dining room has recently been carried out by Ferranti, Limited, of Hollinwood. A new maple floor has been laid, which now makes it possible to utilise the room for social functions. The first event took place on Tuesday of last week, when a very successful dance was held for employees and their friends. A representative gathering from all departments attended and a very enjoyable evening was spent. It is proposed to hold further dances during the winter season, and if one can judge from the success of this initial effort, many pleasant evenings are in store for Ferranti employees. The following evening an exhibition of handicraft was held in the same room, when work of all description done by the employees was exhibited, including some wonderful models. Prizes were awarded for the best work done in each grade. In this same room a stage has been fitted up out of the proceeds of dinner-time concerts, and operatic and dramatic events have already taken place.

Inefficient Colliery Steam Plants.

At a meeting of the Manchester Geological and Mining Society, held a few days ago, in a paper entitled "Fuel Economy in Colliery Steam Plant," Mr. Arthur Grounds stated that the average net efficiency of colliery boilers had been shown to be about 55.5 per cent., compared with a possible efficiency of 70 to 75 per cent., which would mean a saving of about 3,900,000 tons of coal per annum. He said another 2,775,000 tons could be saved by burning refuse coal. In Lancashire and Cheshire,

Mr. Grounds said, the consumption of boiler fuel was 8.46 per cent. of the coal produced—a figure much above the average.

Mersey Docks and Harbour Board.

Reviewing the work of the Mersey Docks and Harbour Board at a meeting held last week, Mr. Thomas Rome, the chairman, said that during the last year more than £60,000 had been spent on additional plant for extending the Gladstone Dock, and more than double the number of men at work last December were now being employed. The provision of increased and improved facilities for overseas passengers at the Prince's landing stage was approaching completion. The chairman said that the oil jetty at the Dingle was ready for use as soon as the various oil companies had laid the pipe lines from their storage tanks to the jetty. These tanks had a storage capacity of 81,500 tons of oil. Signs of improvement in the shipping trade were shown by the number of applications made to the Board for appropriated berths and shed accommodation, and for increased accommodation by companies already holding appropriated berths, coupled with the fact that the number of vessels lying up in the docks had been considerably reduced.

The Cheshire Salt Industry.

It is reported that new salt works are about to be erected at Elton, near Sandbach, by the British Soda Company. Rock salt has been found at a depth of 230ft. below the surface, and saturated brine is also present. It is intended to put down multiple effect evaporators capable of dealing with 100 tons of salt per day.

Traffic Problems in Manchester.

The Manchester Paving and Highways Committee had before it last week the report of a special sub-committee which it had appointed to go into the question of the construction of subways in Manchester to relieve the congestion of traffic. After considering the report the Committee decided to take no further action in the matter.

BARROW-IN-FURNESS, Thursday.

Hematite.

There is any amount of confidence in the hematite pig iron trade, and there is little doubt that there will be even an improvement on present trade when the New Year comes. At present there is talk of more furnaces going in within the next month or so, and this will certainly be the case when the steel works get busier. Makers are booked forward until February and there is a tendency for further development in futures. The placing of the orders for the two battleships has certainly improved the position, and those entrusted with orders are seeking to cover themselves. Trade with the Continent continues to be good, but American trade, now that the effects of the coal strike in the United States are over, is not so good. Business in special qualities continues to be good, with prospects of improvement.

Iron Ore.

The iron ore trade is improving. The local consumption is better and more ore is being brought up. Trade out of the district has not assumed very heavy proportions yet. The Hodbarrow Company is shipping quantities away, but is not very brisk yet. Foreign ore is still being imported in limited quantities until present stocks are reduced.

Steel.

The steel trade is slightly better and the prospects are not so bad, but prices are holding some buyers off yet. The Barrow Steel Works are engaged again in the rail department, but Workington is doing nothing yet, though it hopes to re-start early next year. The Barrow Hoop Mills are partially employed. Foundries are experiencing a better trade and the prospects for the New Year are better.

SHEFFIELD.

(From our own Correspondent.)

The Improving Steel Trade.

THERE is further evidence this week of the expansion in the steel trade, and people are now beginning to talk of a coming boom, and of full employment which will last for years. It takes some time, of course, for the work on large orders to get thoroughly under way, and hence the number of men employed does not show any striking increase. The latest returns from the employment exchanges show a drop of 545 on the week, but there are still 35,883 names on the books. It is fully realised that the winter will be a hard one for large numbers of people, and that the great improvement in trade will not make itself fully felt until the spring. But the improvement is certainly here. The demand for pig iron shows a great increase, coal is almost growing scarce, and the steel furnaces are turning out greater and greater tonnages, both of basic and of acid steel, the former predominating. There is a hardening tendency in the prices of both raw and semi-manufactured steel. Following the 10s. increase on hard basic billets, there has been a similar movement in Siemens acid billets, blooms, and ingots, and, as a consequence, wire rods and other finished products have gone up. There is a very firm market for steel scrap.

Growing Demand for Coal.

There is a greatly improved demand in all sections of the coal trade, and exporters and home buyers are in keen competition. The pits have been working exceedingly well of late, owing to the men being desirous of earning good money for the Christmas holidays, and it is a significant fact that the increased output is quickly disposed of—another indication of the improved demand for all classes of industrial fuel. Prices are firm, and in one or two cases there is a tendency for them to rise, especially in cokes. Blast-furnace coke is not at all easy to obtain. It is considered doubtful whether it is good policy to advance the prices, particularly of cokes, at the present time, in view of the fact that the blast-furnace industry is showing such signs of a revival, which might be in danger of a check if fuel prices went higher.

Mr. Charles Markham's Optimism.

Few are in a better position to judge of the state of the coal, iron and other local trades than Mr. Charles Markham, the well-known chairman of the Staveley Iron and Coal Company, the Parkgate Iron and Steel company, and other concerns. He stated on Monday that there was every prospect of a big boom in trade, and that evidence to that effect was afforded by the improved demand for coal. He said that it would not require much of a trade boom to cause a scarcity of coal, owing to the small amount of pit-sinking undertaken during and since the war. "We have not a ton of pig iron on the stocks at Staveley," he said. "We are pulled out of the place with orders for pig iron. Iron is not ordered unless it is wanted for engineering products, and we are putting another blast-furnace into commission right away." He added that the Parkgate works were also experiencing the benefit of the demand for pig iron. Referring specially to the engineering industry, he said that his own firm at Broad Oaks, Chesterfield, last week received more orders than for many months past.

The Railway Steel Branches.

Those important departments of the steel trade which produce railway supplies are feeling the full benefit of the revival. Business has already come to hand in very satisfactory proportions, and other large orders are confidently expected in the New Year. The demand for buffers and springs is providing full work for one firm, while the spring shops at other establishments are much less quiet than they were a few weeks ago, and larger orders are on hand for axles and tires. It has been announced this week that the Crown Agents for the Colonies have placed an order for locomotive axles with Vickers Limited, and have also given a contract for power plant for machine shops to Robey and Co., of Lincoln, and one for steel boiler tubes to the Chesterfield Tube Company. The Frodingham Iron and Steel Company, of Scunthorpe, has obtained an order for angles, channels, tee bars, &c., from the Admiralty, and among the firms which have booked work for the War Office are the Yorkshire Engine Company, and Cammell Laird and Co. The foundries and forges generally are receiving a little work from locomotive builders, and from makers of other heavy engineering constructions. Orders for wagons continue to come in from both railway companies and private owners.

New Schemes.

It has been announced during the last few days that the Great Northern Railway Company has placed contracts in connection with the widening of the line between Ouse signal-box and Huntingdon. Messrs. Logan and Hemingway, of Doncaster, are the successful tenderers for the general work, while the steel work goes to Sir William Arrol and Co., of Glasgow. The scheme involves a large amount of heavy work and excavation, and the construction of six bridges, including one of three spans over the river Ouse. The Midland Railway Company has definitely decided to carry out improvements on an extensive scale in the neighbourhood of Darley Dale and Rowsley. The present locomotive sheds will be removed to nearer Darley Dale, about a mile and a-quarter away, and accommodation will be provided for about sixty engines. At Scunthorpe there is a demand for several railway improvements. The Employment Committee of the town is pressing the Government to proceed with these works in the interests of the unemployed of the district. The improvements asked for are the extension of the light railway from Winteringham to Barton-on-Humber; facilities for obviating the level crossing at Frodingham Station; increased facilities for dealing with the traffic from the various works; the abolition of the "bottle-neck" at Frodingham sidings; and the provision of a new railway station. With regard to the increased facilities for dealing with the works traffic, this is described as very urgent. It is stated that unless something is done, then, immediately trade becomes normal again, half of the works will have to close down in order to keep the other half going, as the railway facilities at Frodingham sidings are totally inadequate to deal with the amount of mineral traffic which is likely to result.

The Lighter Trades.

The building of the two new warships will benefit a good many trades of Sheffield, besides those which are actually engaged on the manufacture of the ship-plates, armour, and guns. Many of the tools which will be required in the shipyards, the armament and machinery shops are made only in Sheffield. The new construction will considerably stimulate the trades in files, milling cutters, twist drills, pneumatic tools, heavy hammers, and edge tools. At present the file trade, although showing some sign of improvement, is in a very depressed state, and no real revival can be expected until the engineering shops of the country recover their activity. There is little work in twist drills. There is a moderate demand from the motor trade for alloy steels, magnets and tools. The best of the lighter steel branches are those producing farm and edge tools, colliery tools, shovels and spades. Although not fully employed, they show a useful improvement, and some of them are working as much as five days a week. In cutlery and plate, seasonal orders continue to keep some firms busy, while with others the activity is slowing down. Cutlery manufacturers are employed chiefly on stainless table knives, and report but moderate business in spring knives, razors, and scissors. There is a growing production of safety razor blades in the city, which compete with the American article. The outlook for both cutlery and plate is considered promising. With regard to plate especially, a number of good inquiries for supplies in the New Year are already being received.

Sheffield's Ring Road.

The Sheffield City Council has approved a scheme for compulsorily taking land in the neighbourhood of Intake and Gleadless, for the purpose of building a new road between these points. The estimated cost is about £40,000, and the road will form part of the circular road round the city. An application for 50 per cent. of the outlay has been made to the Ministry of Transport, and is now under consideration.

NORTH OF ENGLAND.

(From our own Correspondent.)

A Brighter Trade Outlook.

INDUSTRIAL matters have assumed a somewhat quiet aspect this week. This is a natural result of the approach of a holiday period. There is, however, a confident feeling regarding the trade outlook. During the past few weeks there has been reliable evidence in many directions that the corner of depression has been turned and that a period of greater activity lies ahead. The markets have become steady and more stabilised, buyers are becoming less hesitant, and the Government's push to restore the wheels of industry to full activity is being supplemented by an increasing volume of business in every direction. The revival in the shipbuilding trade is of primary importance to the North-East Coast, for it not only means work for the idle shipyards but also for the steel works. In addition to the placing of the naval work, which is particularly welcome on Tyneside, it is estimated that during the past few weeks orders for forty vessels have been distributed to builders on the North-East Coast, and there are so many inquiries in circulation that it is almost certain that further work will be placed in the near future. It is, however, only by sacrificing profits that builders are able to secure contracts, but after the long stagnation they are content to take work at bare cost to enable their yards to be put into operation. Then there is the prospective development schemes of the railway companies, which should materially benefit the heavy steel trades by the placing of orders for railway material. More and more producing plant is being restarted in the iron and steel works, and it is significant that several ironstone mines have been reopened this week in the Cleveland district.

Cleveland Iron Trade.

The feeling of optimism is growing in the pig iron trade. There is little export demand at the moment, but makers report a remarkably active market in pig iron for home consumption. Buyers seem to have become convinced that no further fall in prices is likely, and they are buying quite freely now for delivery over the first quarter of next year. Thus, although willing to make concessions for prompt business in order to find a market for surplus production over the holiday period, makers are inclined to stiffen prices for forward delivery, and an upward move would create no surprise in view of the fact that makers are selling at or below cost. The demand is certainly broadening, both from the English works and also from Scotland, and the probability is that more blast-furnaces will be put into operation in the New Year. Meanwhile No. 1 and siliceous iron is quoted at 95s.; No. 3 G.M.B., 91s; No. 4 foundry, 85s.; No. 4 forge, 82s. 6d.; and mottled and white, 80s. per ton f.o.b. or f.o.t.

Hematite Pig Iron.

The demand for East Coast hematite pig iron continues very active, large deliveries being made from this district to South Wales. Some of the makers adhere to 93s. 6d. as their figure for mixed numbers, and 94s. for No. 1, but iron can be bought at 6d. per ton cheaper, although that is the full extent of the concession makers are prepared to offer, and any expansion in the demand such as is expected in the New Year may see an advance in price.

Iron-making Materials.

A good volume of business has been put through in the foreign ore trade this week, and the price of best Rubio has advanced to 22s. per ton c.i.f. Tees. There is a very strong export demand for blast-furnace coke, and 31s. is being freely paid for shipment. There is, however, very little surplus for export, and recognising the difficulties of the ironmasters coke makers are selling to them at a preferential rate. Still 29s. 6d. per ton is now an average price for good medium furnace qualities delivered at the works.

Manufactured Iron and Steel.

Further improvement is noted in the manufactured iron and steel trade. The flow of specifications for shipbuilding material is gradually increasing, and for constructional steel there is also a better demand. Dorman, Long and Co., Limited, Middlesbrough, have secured an Admiralty contract for the supply of angles, channels, tee bars, &c., and directly or indirectly the new battleship orders will bring further steel contracts. Prices are maintained.

The Coal Trade.

There are no important changes in the Northern coal trade situation, and the market moves along to the end of the year in a satisfactory condition. The prompt position in practically every instance in both counties is very steady and assured. Beyond weak patches here and there of a temporary character, due to dislocation of turns at the spouts, there is really nothing to complain about. There are in circulation a very large number of inquiries for various periods in next year. Though many of them may be in the nature of feelers and for the sole purpose of testing the possibilities of the market for forward supplies, the bulk of the inquiries is undoubtedly *bona fide*, and

expected to yield a substantial volume of business. The deciding factor is, of course, the price demanded. In this respect the prospects form a most interesting topic of conversation, and there is a considerable variety of opinion as to whether the prices will rise or fall. Most people, however, look forward to a drop of about 2s. per ton as against current figures, though there is little ground at present for such hope. Northumberland steam coals are generally steady, with current values obtainable in every case, while even for smalls there is a slight improvement. The Durham market is exceptionally firm. A number of large producers are very well sold to the end of March next. All the best classes of gas, coking and bunkers are sold out for prompt, while secondary sorts also find a ready spot trade. The coke market is steady and entirely unchanged.

SCOTLAND.

(From our own Correspondent.)

Preparing for Action.

THE past few days have given more promise of better industrial conditions in the near future. Many concerns are not only engaged in clearing up orders before the end of the year, but also making preparations for the new business which is hopefully anticipated. The failure of the Clyde to secure one of the battleship orders has naturally caused considerable disappointment, but this is mitigated to some extent by the steady flow of general orders. Five other contracts were reported last week for vessels upwards of 5000 tons each, and further tenders have been invited. These, with orders already in hand, must mean business for the allied trades in this area.

Extensions at Mossend.

Considerable satisfaction is expressed at Mossend over the decision to make a commencement immediately with the extension scheme in connection with the Clydesdale Steel and Ironworks of Stewarts and Lloyds, Limited, involving the laying down of a large universal rolling mill and several heating furnaces. Several acres of ground have been acquired adjacent to the present works. The new scheme, whilst involving the erection of plate mills, also includes the building of several construction shops. Several months will be necessary in order to complete the work. The contract for the excavations has been secured by the Consolidated Construction Company, Limited, of London. The contractors have ordered from Messrs. Ruston and Hornsby two of their excavators mounted on caterpillar tractors, and these will be supplemented by three other shovels from the contractors' stockyards. The work comprises the excavating and disposing of approximately 200,000 cubic yards of material. A standard-gauge siding will be laid down on the site and three locomotives and from forty to fifty wagons used. Tenders for the locomotives have been invited and specifications for the extensive foundations and buildings will probably be invited after the holidays.

Steel and Iron.

While business at the steel works must still be regarded as slow, conditions are improving, and some makers have already a fair tonnage booked. Inquiries for boiler plates and sectional materials are a little more frequent, and this is regarded as only the beginning of a brighter spell. A firmer tone is noticeable in the market, but additions to prices are not immediately anticipated. Bar ironworks have better home prospects, but would welcome an increase in overseas business. The re-rolled steel department of the industry is in a better position than the iron. Wrought iron is in better demand. Heavy smelting scrap has few inquiries meantime. Pig iron makers are now very short of new business, and makers are beginning to feel some anxiety regarding the disposal of outputs. General export inquiries are fair, but actual business is not encouraging. The home demand is poor, but the better outlook at the steel works is a hopeful sign. Foundry qualities still suffer from continental competition.

Coal.

Very little new business is being entertained in view of the approach of the holidays, and more especially as outputs are practically all booked up at present. This applies to all descriptions of fuel, with the exception of single nuts, pearls, and drosses. A scarcity of steamers has interfered with shipments from the Clyde and the Firth of Forth, while the oversold nature of the Fifeshire collieries continues to have a serious influence in that district. In the last-named area empty wagons are very scarce owing to loading delays, while exporters are still subject to heavy demurrage charges. Aggregate shipments for the week amounted to 286,696 tons, against 331,689 tons in the preceding week and 336,368 tons in the same week in 1913. The home trade continues quiet. Industrial demands are few, while municipal concerns and railways are not buying lavishly.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THE loading pressure at South Wales ports continues to be very heavy, and although there are indications that after the holidays the congestion may be reduced, still everything points to the fact that the steam coal market is likely to be fairly active during the whole of January. The collieries have booked very considerable quantities of coals for shipment certainly during the first half of next month, and the probability is that many buyers abroad who have been holding off in the expectation that prices will weaken will be compelled to come on for their requirements. If the inquiry for January shipment has not been quite up to what was expected, still there is no doubt that a very considerable amount of business has been negotiated and carried through for supplies for delivery over the first half of next year and also for shipment over the whole of 1923. The French State Railways are reported to have bought large and small coals for delivery over the first half of next year, and four local exporting firms have received the orders. The actual quantity booked has not been divulged, but the inquiry was for 30,000 tons of large and a similar amount of smalls. Very substantial inquiries are also in the market from a large shipping undertaking in Italy and the Argentine Railways; but, apart from these, it is interesting to note that business has been concluded for supplies for the United States, while shipments are proceeding to Canada. It is very difficult to say what business exactly has been done already for America, but it is known that tonnage has been chartered to lift 50,000 tons of Welsh two-thirds Admiralty large and one-third smalls during January, February and March next for the North American range of ports. This order is reported to have been arranged on behalf of the Knickerbocker Trust of America, and it is believed that there are other inquiries on the market running to 100,000 tons for shipment to the States during the first half of next year. Business is also being negotiated for anthracite, but these inquiries are very significant, inasmuch as they point to the possibility of trouble being experienced in the American coalfields at the end of March, and it looks very much as if the precaution is being taken to get supplies from this country against the contingency of another American strike. In any event, South Wales coalowners who have sold a fair proportion of their outputs for the first half of next year are now going very cautiously regarding further sales, and they are not inclined to sell any more over a long period unless they can secure much improved prices compared with those which they have already obtained.

Iron and Steel Trades.

There is evidence that the prospects of the iron and steel trades are brighter. Guest, Keen and Nettlefolds, Limited, have received a fair share of the orders for steel plates for the new British battleships, and the Dowlais steel works at Cardiff are being prepared in readiness. It is fully expected that early in the New Year about 600 workmen will have recommenced work. The news has caused a good deal of satisfaction, as the men employed at these works have had a very bad time during the past year or two. It is also reported that the Uskside Engineering Company at Newport has received during the past week or two a very substantial number of orders for various engines, and the work is to be put in hand immediately. It is also interesting to note that during the past few weeks several important orders have been placed by Cardiff firms for new ships, which shows the confidence of local shipowners in the future for shipping, despite the fact that at the moment keen depression prevails and that rates of freight are unremunerative.

Ebbw Vale Trouble.

During the past week or so there has been every appearance that trouble was brewing in the Ebbw Vale area arising out of the Galloway award. On Friday last a number of men at the Waunllwyd Colliery returned home on account of differences concerning the question of payment, and on the following day a meeting of both sides took place with Dr. Galloway at the Miners' Federation offices at Cardiff. A report of these proceedings was afterwards given to a mass meeting of the miners on Sunday, when it was stated that Dr. Galloway had intimated that it was his intention that the award should be interpreted in such a way that would place the Ebbw Vale workmen in no less a favourable position than the workmen in the surrounding districts of Ebbw Vale. It was pointed out that the company undertook to pay the minimum wage to all workmen for the past two weeks and for the next two weeks, and that an investigation would take place respecting wages paid in the surrounding districts. The men decided to follow the recommendation to continue at work for the next fortnight pending these negotiations.

The Buxton Award.

Matters in dispute between the coalowners and the miners respecting the award of Earl Buxton on the question of the subsistence allowance were submitted to the independent chairman of the Conciliation Board at the end of last week. The points submitted had reference to the payment of the subsistence allowance to men who worked overtime and the position of workmen employed on the Sunday night shift at collieries where the men were expected to work that shift. The decision of Earl Buxton was that a workman whose ordinary working week was one of five afternoon or night shifts and who refused during any week to work overtime was not on that account to be deprived of the subsistence allowance to which he would be entitled. A workman is not to be disqualified on the ground of abstention from work on the Sunday night from receiving any subsistence allowance to which he may be entitled, whatever may be the practice at the colliery at which he is employed as regards work on Sunday night. The foregoing ruling favours the contention of the workmen.

Iron and Steel Workers' Wages.

The official announcement is made by the secretary of the South Wales and Monmouthshire Iron and Steel Manufacturers' Association that the joint auditors' report for the three months ending November 30th last shows that as and from January 1st to March 31st next the wages of the workmen following the scale will be 50¾ per cent. above the standard as compared with 51 per cent. as at present.

Colliery Developments.

Arrangements have been made for coal winding operations to commence this week at the new Ogilvie pits near Bargoed, and it is expected that at an early date a substantial output will be obtained. The pits belong to the Powell Duffryn Company. The Ebbw Vale Company's new pit at Blaina is also almost ready, and within the next few weeks it is probable that employment will be found for 500 men.

Current Business.

Coal market conditions continue very firm for practically all classes of steam coal. Colliery books are well filled; in fact, many of the leading undertakings have heavier commitments than they will be able to discharge this side of the Christmas holidays, and it is probable that a fair amount of tonnage will be delayed over the holidays. Undoubtedly the comparatively high prices now prevailing have checked a good deal of inquiry for supplies for prompt shipment, but after the holidays it is expected that the demand will be brisker. There is not much change in the anthracite section. Large coal, cobbles and nuts are about steady, but beans, duff and culm are scarce and firm.

Metal Trades.

The Swansea tin-plate market is firm at 20s. to 20s. 3d. I.C. basis f.o.b. It is expected that the first three months of next year will see a good demand, particularly on continental account.

Coal Orders.

The British Admiralty is reported to have contracted over next year for supplies of best steam coals at 26s. 6d. to 26s. 9d. The quantity is not disclosed. Foreign depôt owners are also understood to have purchased altogether about 600,000 tons of second Admiralty quality large at 25s. 6d. and 25s. 9d.

LAUNCHES AND TRIAL TRIPS.

SAN ROSENDO; steel tank steamer; built by Sir W. G. Armstrong Whitworth and Co., Limited, to the order of the Eagle Oil Transport Company, Limited; to carry 8250 tons of oil. Engines, triple-expansion, pressure 180 lb.; constructed by Wallsend Slipway and Engineering Company, Limited; trial trip, November 16th.

MEDUANA; twin-screw liner; built by Swan, Hunter and Wigham Richardson, Limited, to the order of Cie de Navigation Sud Atlantique of Paris; dimensions, 481½ft. by 59½ft. by 38ft.; to carry 9000 tons. Engines, Brown-Curtis turbines with double-reduction gearing; constructed by Wallsend Slipway and Engineering Company, Limited; trial trip, November 23rd.

INVERURIE; "N" type standard vessel; built by Harland and Wolff, Limited, to the order of the British Mexican Petroleum Company, Limited; dimensions, 428ft. by 55ft. 5in. by 38ft.; capacity, 6900 gross tons. Engines, triple-expansion; constructed by the builders; launch, November 23rd.

SCOTTISH CASTLE; steel oil tank steamer; built by Sir W. G. Armstrong, Whitworth and Co., Limited, to the order of Tankers. Limited; to carry 10,300 tons deadweight. Engines, triple-expansion, pressure 200 lb.; constructed by the builders; trial trip, November 17th.

LUETTA; tanklighter; built by Rotterdamsche Droogdok Maatschappij, to the order of the Caribean Petroleum Company, of Caracas; dimensions, 225ft. by 36ft. by 13ft.; launch, December 2nd.

STAD HAARLEM; steamer; built by William Gray and Co., Limited, to the order of Halcyon-Lijn, of Rotterdam; dimensions, 321ft. 3in. by 46ft. 6in. by 26ft. 3in.; 4800 tons deadweight carrying capacity. Engines, triple-expansion, 25in., 41in., 68in. by 45in. stroke, pressure 200 lb.; constructed by the builders; trial trip, December 2nd.

AYDON, steel screw collier; built by the Blyth Shipbuilding and Dry Docks Company, Limited; dimensions, 275ft. by 40ft. 4½in. beam; to carry 2750 tons. Engines, triple-expansion, 22in., 36in., 60in. by 39in. stroke; constructed by the North-Eastern Marine Engineering Company, Limited; launch, December 5th.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE LONDON ELECTRIC FIRM, of Brighton-road, Croydon, asks us to announce that its works will be closed from this evening till Thursday morning, 28th inst., but that a small staff will be kept in attendance to deal with urgent business.

HYATT, Limited, of 56, Victoria-street, London, S.W. 1, informs us that it has appointed a member of its staff, Mr. G. A. Chapman, to represent it in Manchester and district. Its representation for that district was previously held by Martin Bros., Limited, 35, Bridge-street, Manchester.

DANIEL ADAMSON AND CO., Limited, of Dukinfield, ask us to announce that their works will be closed for the Christmas holidays from to-day until Wednesday, December 27th. For the New Year holidays their works will close on Friday, December 29th, 1922, until Tuesday, January 2nd, 1923. No goods will be received or dispatched between these dates, and only urgent correspondence will be dealt with.

RUSSIAN ENGINEERS.—The Committee for the Relief of Russian Intellectuals, of which Sir Robert Hadfield is president, is making an urgent appeal on behalf of Russian engineers. Assistance is needed for the provision of food and clothing. For £2 5s. a parcel of food, sufficient to sustain a family of six for one month, consisting of 40 lb. flour, 10 lb. sugar, 3 lb. tea, 25 lb. rice, 10 lb. lard, twenty tins of milk, will be forwarded. For £4 10s. a complete outfit of clothing for one person can be supplied. Discarded clothing in fair condition would be gratefully received by the hon. treasurer. All remittances should be made payable and sent direct to the hon. treasurer, R. C. Griffith, at 8, Victoria-avenue, Bishopsgate, E.C. 2.

THE FOURTH BRUSSELS COMMERCIAL FAIR.—The fourth Brussels Commercial Fair will take place, as in the case of the previous Fairs, in the gardens and halls of the Cinquantenaire Park, from April 9th to 25th, 1923. There are to be three different kinds of stands: closed stands, stands in the hall, and open-air stands. It is anticipated that the expenses of the Fair will reach the sum of 4,210,000f., of which 2,782,000f. will be absorbed by the erection of the stands, the decoration of the park, the construction of a temporary building, and the electrical installation; 250,000f. by work in the hall, and 1,180,000f. for general expenses, &c. At the Fair of 1922, which was held from April 3rd to 19th, 2214 firms exhibited, of which 1505 were Belgian, 372 French, and 94 English, twenty-four nations being represented. The whole available space was let and 105 firms had to be refused accommodation.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	22/6
(1) Spanish	22/6
(1) N. African	22/6
N.E. Coast—	
Native	—
Foreign (c.i.f.)	22/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) **Scotland—**		
Hematite	5 7 6	—
No. 1 Foundry	5 0 0	—
No. 3 Foundry	4 15 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 13 0	4 13 0
No. 1	4 13 6	4 13 6
Cleveland—		
No. 1	4 15 0	4 15 0
Silicious Iron	4 15 0	4 15 0
No. 3 G.M.B.	4 11 0	4 11 0
No. 4 Foundry	4 5 0	4 5 0
No. 4 Forge	4 2 6	4 2 6
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
North Staffs. Forge	3 12 6	—
,, ,, Foundry	4 4 0	—
(3) Northampton—		
Foundry No. 3	4 0 0	—
,, Forge	3 10 0	—
(3) Derbyshire—		
No. 3 Foundry	4 2 6 to 4 3 6	
Forge	3 12 6	—
(3) Lincolnshire—		
Basic	4 0 0	—
Foundry	4 2 6	—
Forge	4 0 0	—
(4) **N.W. Coast—**		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 10 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 10 0	10 10 0
Best ,,	12 0 0	—
N.E. Coast—		
Crown Bars	10 10 0	—
Tees	10 0 0	—
Lancs.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	13 15 0
S. Yorks.—		
Crown Bars	11 10 0	—
Best ,,	12 10 0	—
Hoops	14 0 0	—
Midlands—		
Crown Bars	10 7 6 to 10 15 0	
Marked Bars (Staffs)	13 10 0	—
Nut and Bolt Bars	9 12 6 to 9 15 0	
Gas Tube Strip	10 10 0 to 10 15 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) **Scotland—**		
Boiler Plates	12 0 0	—
Ship Plates ¾in. and up	8 15 0	—
Sections	8 7 6	—
Steel Sheets ⅛in. to ¾in.	10 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	17 10 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	9 0 0 to 9 10 0	—
Angles	8 15 0 to 9 0 0	—
Boiler Plates	12 10 0	—
Joists	9 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0 to 14 0 0	
Channels	13 10 0	—
Hard Billets	8 15 0	—
Soft Billets	8 0 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 10 0	—
Light ,,	9 10 0 to 10 0 0	
Billets	8 10 0	—
Manchester—		
Bars (Round)	9 0 0 to 9 10 0	
,, (others)	9 10 0 to 10 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	9 0 0 to 10 0	
,, (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Bessemer Billets	12 10 0	—
Hard Basic	8 15 0	—
Soft ,,	7 10 0 to 7 15 0	
Hoops	11 15 0	—
Soft Wire Rods	10 0 0	—
Midlands—		
Small Rolled Bars	8 15 0	—
Billets and Sheet-bars	7 5 0 to 7 7 6	
Gas Tube Strip	10 0 0 to 10 5 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets (f.o.b. L'pool)	17 5 0 to 17 10 0	
Angles	8 15 0	—
Joists	8 15 0 to 9 0 0	
Tees	9 10 0 to 10 0 0	
Bridge and Tank Plates	9 0 0 to 9 10 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	20/- to 20/3
Block Tin (cash)	£80 0 0
,, (three months)	£81 10 0
Copper (cash)	£64 0 0
,, (three months)	£64 17 6
Spanish Lead (cash)	£25 15 0
,, (three months)	£25 10 0
Spelter (cash)	£37 7 6
,, (three months)	£34 2 6
Manchester—	
Copper, Best Selected Ingots	£6 10 0
,, Electrolytic	£71 0 0
,, Strong Sheets	£96 0 0
,, Loco Tubes	£0 1 1½
Brass Loco Tubes	£0 0 11½
,, Condenser	£0 1 2½
Lead, English	£27 5 0
,, Foreign	£26 0 0

FERRO ALLOYS.

(All prices now nominal)

	Per Ton.	Per Unit
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23	10/6
,, 6 p.c. to 8 p.c. ,,	£21 0 0	8/-
,, 8 p.c. to 10 p.c. ,,	£20 0 0	8/-
,, Specially Refined		
,, Max. 2 p.c. carbon	£54 0 0	20/-
,, ,, 1 p.c. ,,	£64 0 0	22/6
,, ,, 0·75 p.c. carbon	£72 0 0	25/-
,, carbon free	1/7 per lb.	
Metallic Chromium	4/9 per lb.	
Ferro Manganese (per ton)	£15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£11 2 6 scale 5/- per unit	
,, ,, 75 p.c.	19 10 0 scale 6/- per unit	
,, Vanadium	17/- per lb.	
,, Molybdenum	9/6 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£160	
Cobalt	11/- per lb.	
Aluminium (per ton)	£82 to £100	

(British Official.)

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	23/6
,, ,, Ell	24/-
,, ,, Splint	25/- to 27/-
,, ,, Trebles	24/-
,, ,, Doubles	21/9
,, ,, Singles	17/3
Ayrshire—	
(f.o.b. Ports)—Steam	23/6
,, ,, Splint	25/-
,, ,, Trebles	24/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	22/- to 25/-
Screened Navigation	28/-
Trebles	25/-
Doubles	22/-
Singles	17/6
Lothians—	
(f.o.b. Leith)—Best Steam	24/-
Secondary Steam	23/3
Trebles	24/6
Doubles	22/-
Singles	18/-

ENGLAND.

(6) **N.W. Coast—**	
Steams	22/6
Household	46/8 to 57/6
Coke	34/8
Northumberland—	
Best Steams	24/6 to 25/-
Second Steams	21/6 to 22/6
Steam Smalls	12/6 to 14/6
Unscreened	20/6
Household	25/- to 28/-
Durham—	
Best Gas	24/- to 25/-
Second	22/- to 23/-
Household	25/- to 28/-
Foundry Coke	37/- to 40/-

Sheffield—	Inland.
Best Hand-picked Branch	32/6 to 34/9 —
Barnsley Best Silkstone	28/- to 30/- —
Derbyshire Best Brights	24/- to 26/- —
,, ,, House	21/6 to 22/6 —
,, ,, Large Nuts	19/6 to 22/6 —
,, ,, Small ,,	15/- to 16/6 —
Yorkshire Hards	20/- to 21/- —
Derbyshire ,,	19/- to 20/6 —
Rough Slacks	9/- to 11/- —
Nutty ,,	7/9 to 9/9 —
Smalls	3 - to 5/- —
Blast Furnace Coke (Inland and Export)	21/- to 30/-

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	29/- to 30/-
Second ,, ,,	27/6 to 28/6
Best Dry Large	28/6 to 29/6
Ordinary Dry Large	27/6 to 28/6
Best Black Vein Large	27/6 to 28/-
Western Valley ,,	27/- to 27/6
Best Eastern Valley Large	27/- to 27/6
Ordinary ,, ,,	24/- to 26/-
Best Steam Smalls	18/- to 19/-
Ordinary ,,	15/- to 17/-
Washed Nuts	27/6 to 37/6
No. 3 Rhondda Large	29/- to 31/-
,, ,, Smalls	19/- to 21/-
No. 2 ,, Large	23/6 to 24/6
,, ,, Through	19/6 to 22/6
,, ,, Smalls	14/- to 15/-
Coke (export)	37/6 to 45/-
Patent Fuel	28/- to 30/-
Pitwood (ex ship)	32/6 to 33/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	37/6 to 40/-
Seconds	30/- to 32/6
Red Vein	30/- to 32/6
Machine-made Cobbles	50/- to 52/6
Nuts	65/- to 67/6
Beans	42/6 to 45/-
Peas	22/- to 23/-
Breaker Duff	10/6 to 11/-
Rubbly Culm	14/- to 15/-
Steam Coals:	
Large	25/- to 26/-
Seconds	23/- to 25/-
Smalls	10/- to 12/-
Cargo Through	17/- to 20/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Naval Construction.

THE debate on the Navy estimates in the Chamber of Deputies did not cover the entire programme of naval construction, for no reference was made to the light cruisers which it is proposed to build, and the credit of 1045 million francs asked for is intended for the reorganisation of the marine as well as for the construction of a dozen submersibles. It is argued that while the country had to concentrate on military armaments during the war the navy went back to the extent that it is no longer regarded as an efficient arm of defence. The most urgent need is, therefore, to reorganise it on a more scientific basis, with laboratories and facilities for carrying out experimental work, and special attention must be paid to the training of an expert staff, which should be maintained in the highest state of efficiency. As the policy is based upon coast defence, the two chief factors are aeroplanes and submarines, in both of which it is claimed the country is deficient. Of the forty-seven existing submarines, it is stated that only eighteen are of any real military value. There are fifty seaplanes and thirteen airships, but in view of the progress of aviation, it is considered that the airship has become too vulnerable and there is no intention of building others. The programme consists, therefore, in making the coast impregnable with the aid of seaplanes and submarines, which would keep hostile ships at a distance, while cruisers in which protection is entirely sacrificed to speed would assist in keeping the sea route open between France and the North African colonies. The construction of battleships warranted by the Washington Treaty, not yet ratified, although advocated in some quarters, has been abandoned for the time being on account of the necessity of devoting all the funds available to a purely defensive organisation.

Commercial Treaties.

Any hope of a revival of international trade can only be realised when monetary values have become stabilised and definite commercial relations have been established between different countries. A stabilisation of currency is necessary if the fiscal tariffs abroad are to be permanently adjusted to enable importers to know exactly under what conditions they will be able to sell their goods. It is hardly possible to effect such stabilisation except by an arrangement for the reorganisation of international finance, such as, it is hoped, will be arrived at by the proposed Conference in Washington, and as there appears to be a general agreement that something must be done to prevent Germany from precipitating her economical ruin, it is believed that a programme will be evolved at the beginning of the year which will partly restore credit and considerably improve money values on the Continent. The other factor in trade improvement is the carrying out of the policy of protecting new industries which grew out of the necessities of the war. In this country the idea of producing everything for home needs has merely had the effect of increasing the values of certain goods and of arresting the export of products which must be disposed of in foreign markets. Ever since the Armistice interminable negotiations for commercial treaties have been carried out with different countries, which have generally refused to accord advantages when France, in her desire to protect home industries, is unable to offer sufficient reciprocity. So far, commercial treaties have been signed with Spain, Poland and Czecho-Slovakia, and a temporary arrangement has been come to with Italy, pending the completion of negotiations with that country. The negotiations with Belgium have been repeatedly broken off because the French failed to offer adequate concessions, but this week a treaty has been signed with Canada which may be regarded as marking the first real advance in the programme of commercial arrangements and may be followed by others.

Orders from Poland.

In the work of reconstructing Poland the most urgent requirements are those of the agricultural industry which needs considerable quantities of implements and machinery, and the equipment of the railways to facilitate the transport of produce. The Polish Government is prepared to give out orders, but being unable to guarantee payment, negotiations have been carried out for some time past on the basis of bartering produce against manufactured goods, while a group of French manufacturers is associated with a syndicate to finance Poland to the extent of its requirements in railway material and machinery, which are to be satisfied in this country. Although not yet completed, it is understood that the negotiations are sufficiently advanced to justify the belief that some large orders will be distributed amongst French firms. Meanwhile, it is reported that the Polish Government has entered into arrangements with one of the leading banks for the raising of a loan which will be employed for the purchase of a thousand locomotives and tenders. The work will be divided equally amongst Belgian and French builders.

The Rhone Scheme.

For carrying out the scheme to utilise the Rhone, whereby the river is to be made navigable for boats of 1200 tons and hydro-electric installations will be laid down to provide about 800,000 horse-power, the funds are to be supplied by the departments, communes and others directly interested in the undertaking, while a certain proportion will be contributed by the State. The Department of the Seine has an option on 200,000 killowatts, and it has to find 90 million francs to permit of the constitution of the company. How to procure this money at the present moment is a problem. It must be done if the option is to be realised, for the department is depending upon this energy from the Rhone to carry out its vast scheme of electrical distribution in connection with the Gennevilliers power station.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

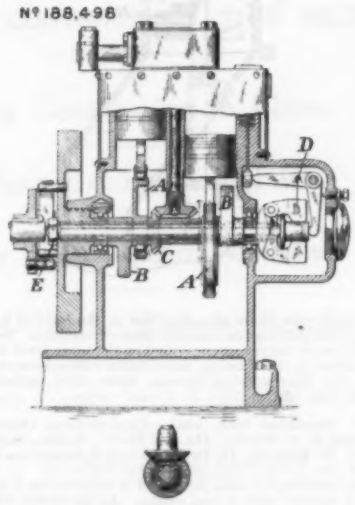
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM ENGINES.

188,498. October 17th, 1921.—ENGINE MAIN SHAFTS, H. R. Ricardo, 21, Suffolk-street, Pall-mall, London, S.W. 1.

ACCORDING to this specification, the usual cranks of a high-speed steam engine are replaced by large excentrics having roller bearing straps. This arrangement permits the use of a continuous straight shaft, which is splined to recieve the excentric sheaves, &c. The sheaves A A, together with their balance

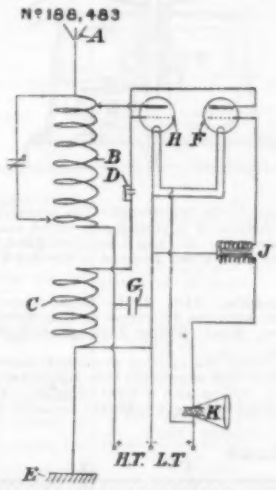


weights B B, the valve gear C, governor D, bearing sleeves and fly-wheel are all threaded on to the splined shaft and held in place by the nut E. It is suggested that it may be necessary to produce a permanent torque between the several members to keep them bearing against the splines of the shaft.—*November 16th*, 1922.

TELEGRAPHS AND TELEPHONES.

188,483. October 4th, 1921.—RADIO-TELEPHONE TRANSMITTER, Harold Stephen Walker, of Park Lodge, Brentford, Middlesex.

This invention relates to radio transmitting apparatus of the kind in which a three-electrode modulating valve is connected in the grid circuit of a power or oscillation valve for impressing amplified pulsations of potential on the grid of the power valve. The main object of the invention is to provide improvements in such apparatus, whereby the amplifying effect of the modulating valve will be materially increased and the use of a small modulating valve adapted to pass only a feeble current is

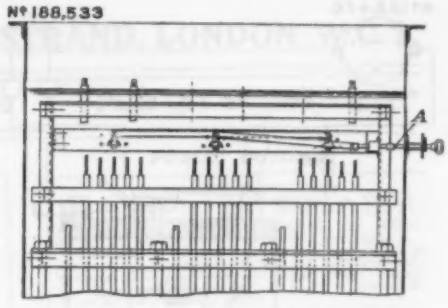


accordingly rendered practicable. A further object of the invention is to provide means whereby the usual choke coil may be dispensed with. The letters indicated in the drawing refer to:—A, aerial; B, aerial inductance; C, grid circuit inductance; D, grid-leak and condenser; E, earth; F, control or modulating valve, also termed amplifying valve; G, condenser of about 2 mf.; H, power valve or valves; J, microphone transformer with low resistance primary; K, low-resistance microphone.—*November 16th*, 1922.

TRANSFORMERS AND CONVERTERS.

188,533. November 11th, 1921.—IMPROVEMENTS IN TAPPING SWITCHES FOR CHANGING VOLTAGE RATIOS OF TRANSFORMERS OR THE LIKE, Stanley Austin Stigant, of 2, Aberdeen-terrace, Blackheath, S.E. 3; Oscar Edward Scase, of 51, Priolo-road, Charlton, S.E. 7; and Johnson and Phillips, Limited, of Charlton, S.E. 7.

The object of this invention is to provide means for conveniently and quickly changing the voltage ratio of the windings of alternating-current transformers, and in the case of polyphase transformers changing the voltage ratio of the various phase windings simultaneously, such changes being effected by means of a switching device mounted within the transformer tank or casing, but operable from outside. The fixed contacts and movable contacts of the switching device are both mounted upon an insulating terminal bar or board which is carried by the

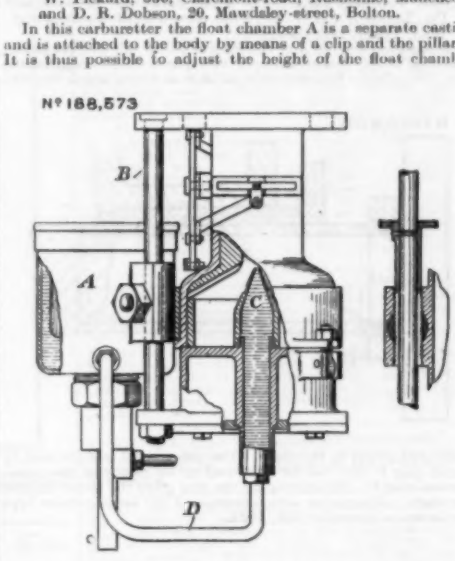


transformer structure, and the movable contacts are actuated by means of a pull rod A which extends through the wall of the casing or tank, so as to be operable from the outside without in any way disturbing any part of the casing or any permanent connections of the apparatus.—*November 11th*, 1922.

INTERNAL COMBUSTION ENGINES.

188,573. December 22nd, 1921.—FLOAT FEED CARBURETTERS W. Pickard, 536, Claremont-road, Rusholme, Manchester and D. R. Dobson, 20, Mawdsley-street, Bolton.

In this carburetter the float chamber A is a separate casting, and is attached to the body by means of a clip and the pillar B. It is thus possible to adjust the height of the float chamber,

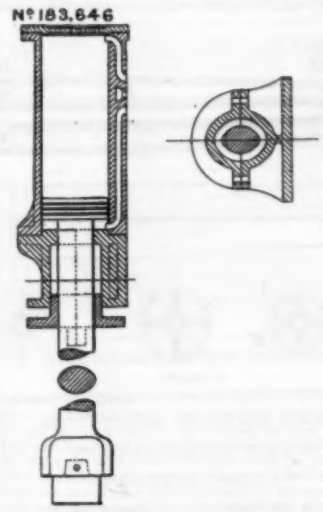


with regard to the jet C, in order to obtain the best working conditions. The connecting pipe D is sufficiently flexible for the purpose. The detail drawing indicates a method of making the vertical adjustment positively.—*November 16th*, 1922.

MACHINE TOOLS AND SHOP APPLIANCES.

183,646. May 26th, 1921.—STEAM HAMMERS, A. Scotland Marshall, 117, Cardross-street, Dennistoun, Glasgow.

The inventor claims that this style of hammer piston-rod is cheaper in manufacture and more satisfactory generally than



the usual type with one or more flats planed along it to prevent it rotating in the stuffing-box. He employs instead an elliptical rod, as shown, which is made in one operation. The stuffing-box and gland are also shaped elliptically.—*August 3rd*, 1922.

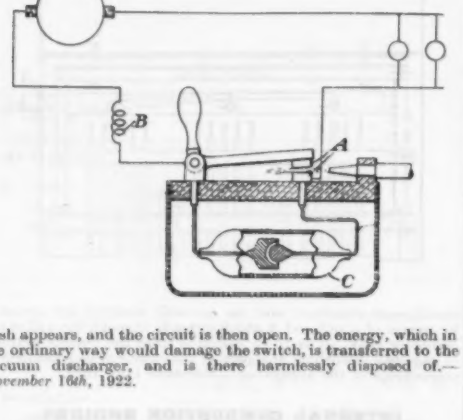
SWITCHGEAR.

188,476. September 2nd, 1921.—IMPROVEMENTS IN AND RELATING TO ELECTRIC SWITCHES, *The British Thomson-Houston Company, Ltd.*, 83, *Cannon-street, E.C.* 4.

The object of this invention is to obviate as far as possible any injury to a switch on opening a circuit. When the switch contacts A are opened, a jet of air passes between the contacts,

as shown, and this greatly raises the impedance of the ionised air gap. The potential across the contacts A rises considerably above the normal, especially if there is any reactance in the circuit, as shown at B. The rise of potential causes a discharge to occur in the vacuum tube C, in which a blue or purplish

N° 188,476



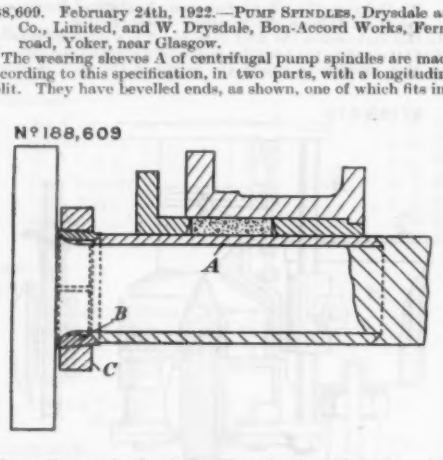
flash appears, and the circuit is then open. The energy, which in the ordinary way would damage the switch, is transferred to the vacuum discharger, and is there harmlessly disposed of.—*November 16th*, 1922.

PUMPING AND BLOWING MACHINERY.

188,609. February 24th, 1922.—PUMP SPINDLES, Drysdale and Co., Limited, and W. Drysdale, Bon-Accord Works, Ferry-road, Yoker, near Glasgow.

The wearing sleeves A of centrifugal pump spindles are made, according to this specification, in two parts, with a longitudinal split. They have bevelled ends, as shown, one of which fits into

N° 188,609



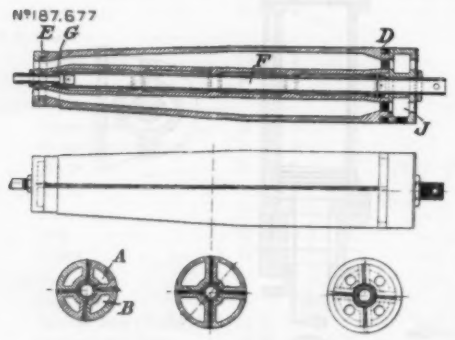
a dovetail recess in the shaft. The other bevel is embraced by a split ring B that can be tightened up by means of the taper-screwed ring C. Tightening up the ring grips the sleeve against the shaft. Alternative arrangements of the same general type are shown.—*November 16th*, 1922.

MISCELLANEOUS.

187,677. July 18th, 1921.—IMPROVEMENTS IN AND RELATING TO CHILLS, Kenelm Charles Appleyard, of Birtley, Durham; Walter Evelyn Manners, of Birtley, Durham; Percival Wentworth Bewicke, of Bedford House, Newmarket, Cambridge; Sir Joseph Frederick Laycock, of Wiseton Hall, Bawtry, Nottingham; and Maurice Raymond Portal, of Holywell, Swansmore, Hants.

A number of tapering hollow chills are provided, and when assembled with the necessary packing they form in section an annular ring. Some of the chills are more tapered than the others. Four chills will be found sufficient in an average case. The chills are held together by means of steel or iron retaining rings D and E and are mounted on a hollow spindle F shaped at its ends to coincide with the faces on the chills which are simi-

N° 187,677



larly shaped. At one end of the chills an internally screwed expanding cone G is provided and adapted to engage with an inlet pipe held in position by a lock-nut. At the opposite end of the chills an air or water box J is arranged, the box being provided with an inlet and an outlet hole to each of the chills. Inspection holes and a cover are also provided. The object of the invention is to provide a chill which will not offer any resistance during the contraction of the casting, and the method of using the device is fully described.—*October 18th*, 1922.

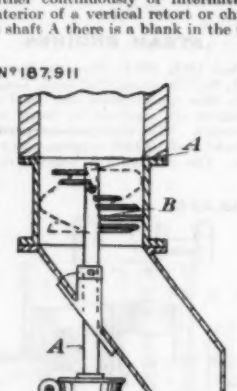
188,370. July 29th, 1921.—A METHOD OF INCREASING THE OUTPUT OF GAS FROM ELECTROLYTIC APPARATUS, Eugenio Vesme, of Corso Vittorio Emanuele, No. 121, Turin, Italy.

It is known that the output of gas in electrolytic apparatus in which the electrolyte is decomposed, by the action of the current, into its gaseous elements, is proportional to the strength of the current. It follows that in order to increase the output from a given electrolytic installation, it is necessary to increase the strength of the current and at the same time the voltage, so that the energy consumed increases in proportion to the square of the increase in the output of gas and the efficiency of the apparatus is very greatly diminished. According to the present invention this disadvantage is eliminated by combining with an increase in the strength of the current a lowering of the resistance of the electrolyte, which enables the strength of the current to be raised without also raising the voltage, at the same time keeping the relation $C = \frac{E}{R}$ constant. In this way the normal output of gas can be augmented with an increase in the consumption of energy corresponding directly to the increase in the output of gas. The lowering of the resistance is effected by heating the electrolyte.—*October 30th*, 1922.

187,911. March 10th, 1922.—IMPROVED MEANS FOR EXTRACTING COKE FROM VERTICAL RETORTS OR CHAMBERS, R. and J. Dempster, Limited, and William Francis Rodger, all of the Gas Plant Works, Oldham-road, Manchester.

This specification describes a rotary coke extractor which, when rotated either continuously or intermittently, removes coke from the interior of a vertical retort or chamber. At the upper end of the shaft A there is a blank in the form of a helix.

N° 187,911

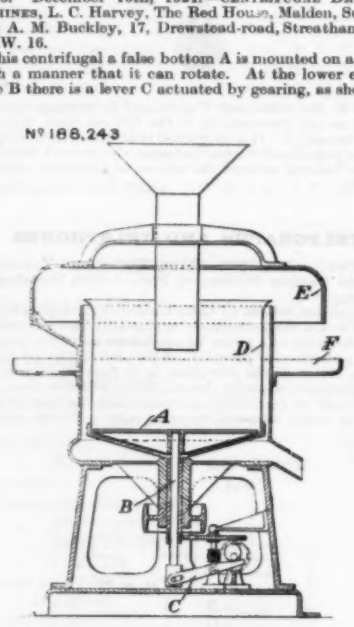


A number of rods B are also provided in the form of a helix in respect to the path or line through their extremities. Two other series of rods or helices are provided at the same level, but they are not shown in the drawing, only broken curves being shown to indicate the lines passing through their other extremities.—*November 2nd*, 1922.

188,243. December 16th, 1921.—CENTRIFUGAL DRYING MACHINES, L. C. Harvey, The Red House, Malden, Surrey, and C. A. M. Buckley, 17, Drewstead-road, Streatham London, S.W. 16.

In this centrifugal a false bottom A is mounted on a spindle B in such a manner that it can rotate. At the lower end of the spindle B there is a lever C actuated by gearing, as shown, from

N° 188,243

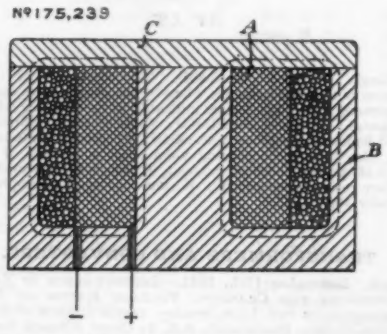


the main spindle of the centrifugal. The arrangement is such that the false bottom A is periodically raised and pushes the charge out of the basket D when it has been dried. The charge is caught by the cover E and drops on to the tray F.—*November 9th*, 1922.

175,239. September 21st, 1921.—IMPROVEMENTS IN AND CONNECTED WITH THE MOUNTING OF ELECTRIC CONDUCTORS IN CASINGS, Fried. Krupp Aktiengesellschaft, of Essen, Germany.

The space between the exciting winding A and the wall B of the casing is filled with aluminium balls embedded in putty and coated on their surface with a layer of oxide. The magnetic field created by the winding A holds the armature C in position,

N° 175,239

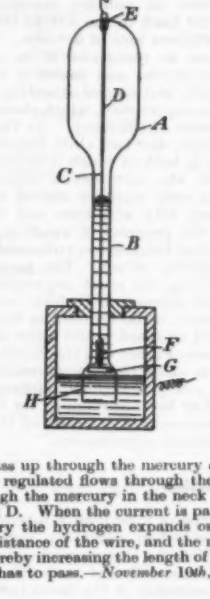


and the heat generated by the coils is transmitted through the aluminium balls to the walls of the casing. Owing to the rapid transfer of the heat from the coil to the atmosphere, the coil can carry a much heavier current than usual.—*November 16th*, 1922.

188,400. August 10th, 1921.—IMPROVED MEANS FOR REGULATING THE STRENGTH OF ELECTRIC CURRENTS, Charlton Stanford Agate, of 76, Beaddow-road, Chelmsford, and Albert Edward Hill, of 21, Hamlet-road, Chelmsford.

A is a bulb having a long neck B depending from it. C is an iron wire supported by a rod D of platinum of sufficient cross section not to be heated appreciably by the passage of the working current. This rod is sealed into the top of the bulb at E. The bottom of the wire C is connected through a spring F to a plug G fitting into an enlargement H at the bottom of the neck B. The bulb and neck are filled with mercury and then inverted in a bath of mercury contained in an iron box. Hydrogen is

N° 188,400



then allowed to pass up through the mercury and fill the bulb. The current to be regulated flows through the mercury in the bath and up through the mercury in the neck and through the wire C and the rod D. When the current is passed through the wire to the mercury the hydrogen expands on account of the heat due to the resistance of the wire, and the mercury is forced down the stem, thereby increasing the length of the wire through which the current has to pass.—*November 10th*, 1922.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

THE JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria street, S.W. 1. Social evening. 7.30 p.m.

THURSDAY, DECEMBER 28TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Juvenile Lecture, "Six Steps Up the Ladder to the Stars"—I.: "Distance of the Stars," by Dr. H. H. Turner. 3 p.m.

FRIDAY, DECEMBER 29TH.

THE JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Lecturette, "Brewery Engineering" (slides), by Mr. C. F. Morgan. 7.30 p.m.

SATURDAY, DECEMBER 30TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Juvenile Lecture, "Six Steps Up the Ladder to the Stars"—II.: "Discovery of Neptune," by Dr. H. H. Turner. 3 p.m.

1923.

MONDAY, JANUARY 1ST.

INSTITUTE OF TRANSPORT.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Paper, "Air Transport," by Mr. F. Handley Page. 5.30 p.m.

WEDNESDAY, JANUARY 3RD.

INSTITUTION OF SANITARY ENGINEERS.—Caxton Hall, Westminster, S.W. 1. Presidential address. 7.30 p.m.

FRIDAY, JANUARY 5TH.

THE JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Lecturette, "Wave Power Transmission," by Mr. W. Dinwoodie. 7.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS: MANCHESTER CENTRE.—College of Technology, Sackville-street, Manchester. Paper, "South African Railways and Rolling Stock," by Mr. H. K. Bamber. 7 p.m.

SATURDAY, JANUARY 6TH.

WEST YORKSHIRE METALLURGICAL SOCIETY.—Great Northern Hotel, Bradford. Smoking concert. 7 p.m.

WEDNESDAY, JANUARY 10TH.

ASSOCIATION OF ENGINEERS-IN-CHARGE.—St. Bride's Institute, Bride-lane, Fleet-street, E.C. 4. Paper, "The Selection of Fans and their Application," by Mr. A. Fleming Brown. 7.30 p.m.

SATURDAY, JANUARY 13TH.

INSTITUTION OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Grand Hotel, Manchester. Smoking concert. 6 p.m.

CONTRACTS.—The Pulsometer Engineering Company, Limited, of Reading, has received from the Great Western Railway Company an order to supply and erect an hydraulic pumping installation consisting of four Pulsometer turbine centrifugal pumps designed for a working pressure of 800 lb. per square inch, each pump being direct coupled to a 6000-volt electric motor of 650 brake horse-power. The pumps are to be capable of delivering 800 gallons of water each per minute. Auxiliary low-pressure pumping machinery and switchgear for automatic operation are also included in the contract. The installation is intended for dock service at Cardiff.—The Admiralty has placed a further contract with Joseph Kaye and Sons, Limited, of 93, High Holborn, London, W.C., and Lock Works, Leeds, for their patented seamless serrated steel oilcans.